SMALL MAMMAL FAUNAL STASIS IN NATURAL TRAP CAVE (PLEISTOCENE–HOLOCENE), BIGHORN MOUNTAINS, WYOMING

BY

C2009
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Submitted to the graduate degree program in Ecology and Evolutionary Biology
and the Graduate Faculty of the University of Kansas
in partial fulfillment of the requirements for the degree of
Doctor of Philosophy.

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Date defended: April 21, 2009

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ABSTRACT

Paleocommunity behavior through time is a topic of fierce debate in paleoecology, one with ramifications for the general study of macroevolution. The predominant viewpoint is that communities are ephemeral objects during the Quaternary that easily fall apart, but evidence exists that suggests geography and spatial scale plays a role. Natural Trap Cave is a prime testing ground for observing how paleocommunities react to large-scale climate change. Natural Trap Cave has a continuous faunal record (100 ka–recent) that spans the last glacial cycle, large portions of which are replicated in local rockshelters, which is used here to test for local causes of stasis. The Quaternary fauna of North America is relatively well sampled and dated, so the influence of spatial scale and biogeography on local community change can also be tested for. Here I use the herbivorous and omnivorous small mammal fauna (<5 kg) of Natural Trap Cave, which are more likely to be members of a local paleocommunity than more mobile large mammals and carnivores. A significant proportion of the fauna is present throughout the record and these are primarily arid and open-habitat adapted, or generalist, taxa that are predicted to find the full-glacial environment of northern Wyoming suitable in any case. An invasion of arctic and alpine tundra taxa occurred during the Last Glacial Maximum, but these were extirpated locally following the deglaciation. The regional ecosystem surrounding Natural Trap Cave also had significant faunal carryover (>50%). The likely cause for the local stasis in Natural Trap Cave is distance from the modern northern and southern edges of the member taxa distributions, a reflection of their broad range of adaptation. North–south oriented mountain barriers preserve the integrity of the regional fauna by allowing habitat-tracking down-elevation. These mountain barriers also limit east–west dispersal from neighboring faunal provinces.

Acknowledgments

I wish to thank L. D. Martin for making the Natural Trap Cave collection available for study, critical input, and manuscript review. S. A. Chomko, B. M. Gilbert, and J. Chorn for answering questions regarding excavation of Natural Trap Cave and the rockshelters, R. M. Timm for KUM collections use and manuscript review, J. Bradley and J. Kenagy of UWBM for specimen loans; B. Lieberman, B. Foster, and W. Johnson for manuscript review, S. Klopfenstein and S. Maher for GIS help, N. Slade for discussions on nonparametric statistics, financial support from the KUNHM/BRC Panorama Grant program, C. Baxter for comments on leporid identification, S. Hasiotis for IchnoBioGeoScience Lab equipment use, and Liz for life support.

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CHAPTER 1

Introduction

The nature of communities in neoecology is a long running debate that can be traced to the works of Elton and Gleason (Gleason, 1926; Elton, 1966), which were diametrically opposed on this level: Elton (1966) argued that communities were stable super-organisms held together by interactions between species, whereas Gleason (1926) thought that communities were loose agglomerations of species occupying a single space at any given time. Both models have consequences for paleocommunities, also known as biofacies, in geological time. Communities that perform under the model of Elton (1966) would result in biofacies that are stable in membership through time until being overwhelmed by environmental change. Conversely, biofacies that operates under Gleason's (1926) model would be expected to change rapidly as species constantly invaded and abandoned a community. The property of community stability has import for the study of evolution in the fossil record as well. Observed cases of paleocommunity stasis correlate with periods of limited speciation and extinction, so stasis may be an explanation for observed cases of punctuated equilibria in many taxa (Lieberman and Dudgeon, 1996).

The data used by paleoecologists is often different from the data of neoecology, but has the valuable attribute of long temporal spans. Ecologists can sample organisms from an environment and document interactions among avatars (local economic populations of a taxon) that are members of a community, but only over the course of decades at most. Paleoecologists can only infer interactions between avatars through spatial proximity of remains in a single outcrop, but they can trace change over time scales of millions of years. Paleoecological data has obvious limitation pertinent to theories of community interactions however. The spatial

proximity of fossils is not an indicator of co-occurrence, as has been documented for shell beds which often contain individuals differing in age by as much as a thousand years (Miller, 1986; Bennington and Bambach, 1996). Despite the time averaging inherent in most fossil assemblages, catastrophic-event faunas being the exception, the observation of recurring regional associations of taxa allows the inference of regional ecosystems. Hadley (1996) noted that the late Holocene mammals from Lamar Cave, Yellowstone National Park, WY were a good sample of the surrounding habitat types in the local community. Lamar Cave shows that in some cases it may therefore also be possible to make inferences about local communities based on biofacies. With these qualifications in mind, fossil assemblages on the local scale (single outcrops, caves, etc.) have been termed as paleocommunities (Miller, 1987), local ecosystems by Miller (2002), or even more loosely as biofacies (Morris et al., 1995). I refer to the small mammal record reported on here as a biofacies, because this term recognizes co-occurrence in a fossil assemblage yet makes no inferences on interactions between taxa.

Paleocommunity stasis is a pattern that is noted throughout the fossil record in varying organisms and biotic settings (reviewed in DiMichele et al., 2004). The concept of biofacies, as old as the study of biostratigraphy, is rooted in this phenomenon of paleoecological stasis. Brett and Baird (1995) recognized and described what they termed "coordinated stasis" in the benthic marine paleocommunities of the Paleozoic Hamilton group. Coordinated stasis is the recurrence of a similar biofacies wherever the appropriate environmental conditions are met over the scale of several million years (Brett et al., 1996). Brett and Baird (1995) found that 80% of taxa within a certain biofacies persisted throughout the entire time span represented in the Hamilton group. These biofacies were resilient to high-frequency environmental change (large die-offs caused by anaerobic conditions, storms, changes in clastic input) until a major environmental

change occurred, usually millions of years later. These species typically occur in the same relative abundance as well. Brett and Baird (1995) specifically applied coordinated stasis to the regional Hamilton ecosystem, not to local outcrops.

Brett et al. (1996) also noted that periods of paleoecological stasis corresponded with morphological stasis in the regional ecosystem's member taxa. Not only were Hamilton biofacies nearly constant in membership and guild structure through time, the member taxa were also in morphological stasis. Morphological change observed in Hamilton Group taxa was not directed, but varied around a static mean. Lieberman et al. (1995) gave a quantitative example of morphological stasis in two brachiopod taxa from the Hamilton Group. Correspondingly, successful speciation is rare in the Hamilton group (Eldredge and Gould, 1972; Brett et al., 1996). The combination of paleoecological and morphological stasis led Brett et al. (1996) to consider blocks of coordinated stasis as subunits of Boucot's (1983, 1990) global Ecological Evolutionary Units (EEU's). Boucot (1983) based the EEU classification on shelf-depth benthic marine paleocommunities that would occur for millions of years and then be broken apart by extinction events during relatively short periods of geologic time.

In the Quaternary (2.6 Ma–present), the possible temporal resolution increases relative to the Paleozoic and community dynamics can be studied on time scales intermediate between that of earlier geologic time and modern neoecology (Walker and Geissman, 2009). Within the Paleozoic, the minimal time scale that can be studied in a single locality is often on the order of 10,000 years, while minimum resolution can often be reduced to 1,000 years in the Quaternary. This is especially true for the last 50–60,000 years because of AMS radiocarbon dating. Therefore, a period of coordinated stasis as defined above should last all of the Quaternary. The dynamic nature of Quaternary climate, with glacial cycles lasting 41 ka in the early Quaternary

until a shift to 100 ka at 1.2 Ma (reviewed in Cronin, 1999), leads to the inference that coordinated stasis should not last more than one glacial cycle. Vrba (1992), Lister (2004), and Bennett (1997) have shown how habitat changes caused by glacial cycles could lead to extinction, range change, or more rarely, speciation in terrestrial vertebrates.

Evidence for paleocommunity stasis spanning glacial-interglacial cycles is found in the Quaternary within several taxonomic groups. Pandolfi (1996) documented one of the best-known examples of Quaternary paleocommunity stasis in coral assemblages from New Guinea. Pandolfi (1996) compared multiple episodes of coral building across a 95,000-year record spanning several transgression-regression cycles and found each coral building event showed less taxonomic change than would be expected from random species invasions. Stasis is found in terrestrial vertebrates as well. Vrba (1985) found that when Neogene African bovids were examined at the continent-wide scale, they diversified in a relatively synchronous manner, which is predicted by the coordinated stasis pattern. Riddle (1998) found that at the scale of geomorphologic provinces, Late Pleistocene North American rodents either remained in one province or in neighboring areas throughout the last glacial-interglacial transition. Thus, the pattern of rodent stasis is at least in part forced by geographic boundaries that constrained individual species rather than community interactions. Alroy (1999) analyzed the distributional changes of disharmonious mammal species pairs, taxa that do not occur together today, in the late Pleistocene and found they maintained stable associations through long blocks of time, thus implying community stasis. Lyons (2005) divided the FAUNMAP database (Graham et al., 1996) of Late Quaternary mammals into sampling quadrats and tested against a null hypothesis of independent range changes formed from randomly sampled distribution shifts from the fossil record. Geographic quadrats were found that were more similar through time than the null

model, thus showing there were large regions with faunas that remained similar during the deglaciation (Lyons, 2005). McGill et al. (2005) found similar results in a sampling of North American Pleistocene faunal lists from the literature using neutral theory from modern ecology as a null hypothesis. McGill et al. (2005) also examined the effect of geography and time on community stasis and found 1,000 km and 100,000 years to be the defining geographic and chronologic limits on stasis in the Quaternary. It is notable that McGill et al.'s (2005) chronologic time limits on stasis correspond with the 100 kyr glacial cycle active during the late Quaternary. Therefore, there is some evidence for communities acting in a deterministic fashion during the Quaternary period.

Others have argued for a Gleasonian community model in Quaternary mammals by focusing on the concept of the disharmonious fauna (Graham and Grimm, 1990). Disharmonious fossil species associations, those that include species that are allopatric today, imply that respond to ecological change in accordance with their individual limits. The FAUNMAP database (Graham et al., 1996) of Quaternary North American mammal distributions emphasized the individual nature of species' distribution shifts through an analysis of individual taxa that had fossil occurrences outside their modern range. Taxa that were associated during the Pleistocene shifted their ranges in different directions during the Holocene, apparently moving independently of one another (Graham et al., 1996). Conversely, these taxa did undergo range shifts in large faunal suites, which may be evidence for resilient communities tracking preferred habitat.

Community stasis in Quaternary North American mammals is primarily studied on large scales. While Brett and Baird (1995) characterized coordinated stasis as a phenomenon of the regional ecosystem and not the local community, coordinated stasis should leave a recognizable

signature on a local community. The first response of a community's component species to environmental change is habitat tracking (Eldredge, 2003). Therefore, a static fossil locality would record a local community as a biofacies when the community moved through the area tracking its preferred habitat. This would result in a pattern of biofacies recurrence in a single locality. The neglect of local faunas is also forced by the nature of fossil deposition, either due to a lack of chronologic control or because the fauna does not cover a time span long enough to record biofacies change. Those that have analyzed faunal change in one locality (Porcupine Cave by McGill et al., 2005) have not addressed variables that could confound results, particularly local variability in species distribution. Bennington and Bambach (1996) and Bennington (2003) noted that patchiness in the spatial distribution of benthic marine communities could result in unforeseen variability in samples taken from the same outcrop. Replicate sampling in Quaternary localities is often not available however. Fortunately, the taphonomy of fossil deposition in cave sites can be expected to blur living community patchiness to a certain degree through time averaging and multiple methods of deposition such that several community types near the cave are sampled. Hadley (1996) found this to be the case in the late Holocene record from Lamar Cave, Yellowstone National Park, Wyoming. Taphonomy may change over longer time intervals however, whether through changes in a cave's topography or a turnover in predators using the cave as shelter, and result in a change in taxa present in the fauna.

Natural Trap Cave offers a chance to study coordinated stasis on a local scale while still addressing the issues of taphonomy and patchiness. Natural Trap Cave has chronologic control and depth, the cave fauna covers the last glacial cycle (~100 ka–present). There are no major taphonomic breaks within the fauna, the small mammals were primarily accumulated by owls, diurnal raptors, and mammalian carnivores in the immediate vicinity of the cave and then

transported into the cave by woodrats (*Neotoma*). The area surrounding Natural Trap Cave offers replicate sampling to analyze the effect of patchiness on faunal composition. Prospects Shelter, located ~200 m south of Natural Trap Cave has a small mammal fauna that spans the last glacial maximum and deglaciation. (~32–10 ka). Eagle Shelter, located 1.2 km NW of Natural Trap Cave, has not been sampled as extensively, but offers a small Holocene fauna that can be qualitatively compared to Natural Trap Cave (Chomko, 1982). Juniper Cave, which is located on the valley wall opposite Prospects Shelter, also preserves a Holocene and late Pleistocene fauna, although the earliest Holocene and much of the last glacial maximum is not preserved in the cave (Kelly et al., 2002). Hole-in-the-Wall Shelter, located on the eastern side of Little Mountain (Fig. 1), has a small mammal fauna collected from a raptor guano deposit, the bottom of which dated to 1.3 ka (Chomko, 1980).

Locality Setting and Chronology

Natural Trap Cave (NTC) is located in eastern Bighorn County, in north-central Wyoming on the western edge of the Bighorn Mountains at an elevation of 1500 m. The cave is located on Little Mountain, a low plateau bounded on the W and NE by the Bighorn River and Porcupine Creek, respectively; the Bighorn Mountains are ~13 km SE of Natural Trap Cave (Fig. 1). Little Mountain is split into three levels, the upper plateau is 300 m above the middle level, which is ~100 meters above the lowest level. The second level, on which Natural Trap Cave is located, is dissected on the SW and NE by numerous small canyons. Plant communities on the level areas of Little Mountain are composed of sagebrush (*Artemisia*) steppe with pockets of juniper–mountain mahogany (*Juniperus–Cercocarpus*) communities on the steep slopes. The canyon next to Natural Trap Cave is particularly deep (30 m next to NTC) and supports remnant populations of Limber Pines (*Pinus flexilis*), Douglas Fir (*Pseudotsuga menziesii*), and

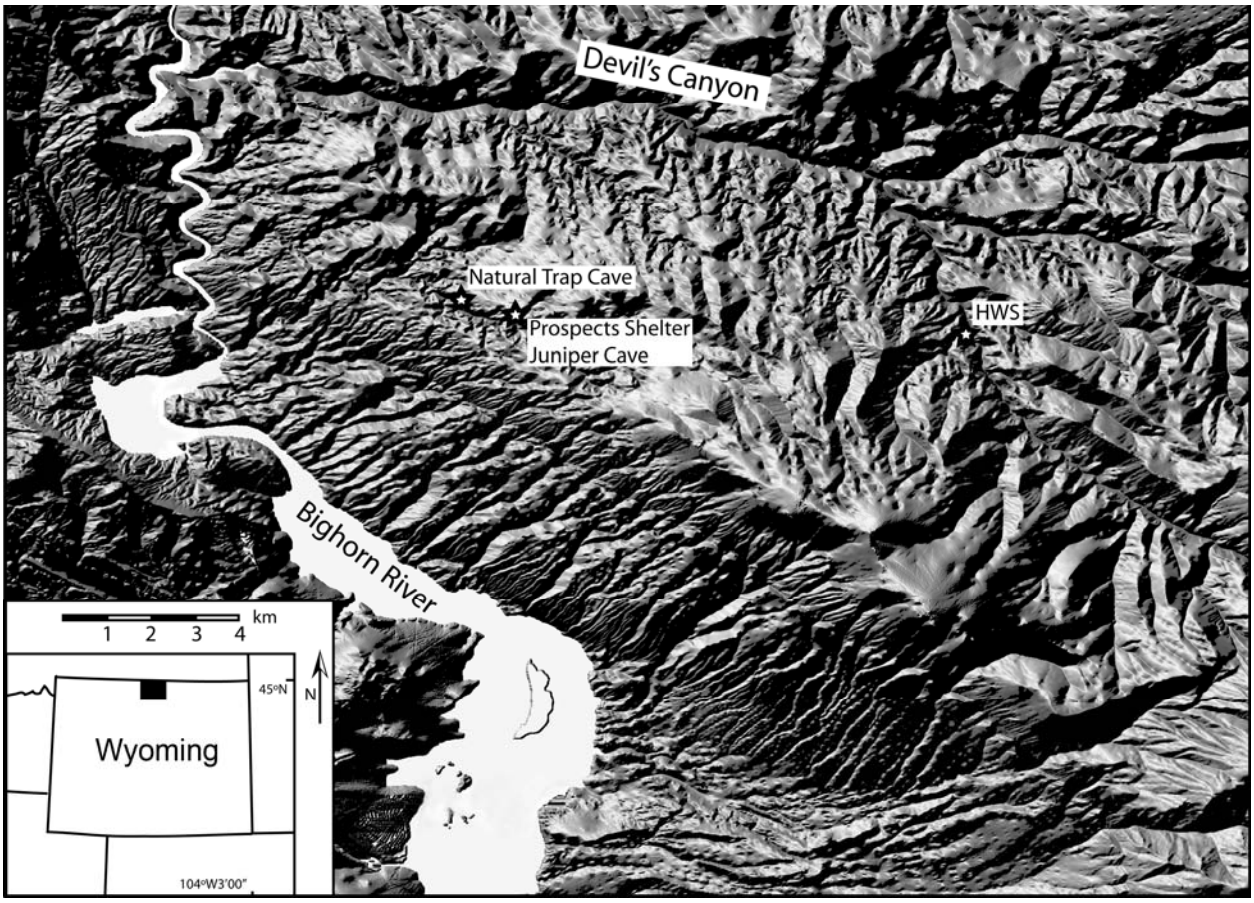


Figure 1. Topography of the area surrounding Natural Trap Cave.

Englemann Spruce (*Picea engelmannii*) on north-facing slopes. Larger stands of coniferous forests are present at higher elevations southeast of Little Mountain in the valleys around Mexican Hill. Approximately 1600 m above Natural Trap Cave the open conifer woodland gives way to stands of Douglas fir (*Pseudotsuga menziesii*), Lodgepole Pine (*Pinus contorta*), and finally a mixed spruce-fir forest (Despain, 1973). Below Little Mountain, grassland gives way to the chenopod-steppe and arid desert shrublands of the Bighorn Basin (Knight, 1994).

Natural Trap Cave is located in the transition zone between two biomes with markedly different physiography, the arid saltbush steppe of the Wyoming Basin and the cool coniferous forests of the Bighorn Mountains (Bailey, 1998; Brown et al., 1998). The Big Horn Basin to the west consists of plains interrupted with low hills. The Big Horn Mountains rise from an average

elevation in the foothills of 900–1,220 m to 4,018 m at Cloud Peak (Despain, 1973). Natural Trap Cave is also within 100 km of the short grass prairie of eastern Wyoming and central Montana.

The climate in the Big Horn Basin is dry with severe winters and summers, while the Big Horn Mountains receive more precipitation with severe winters and more mild summers. In the basin (900 m) the range of average yearly rainfall is 125–250 mm with temperatures ranging between -40–40 ºC. With potential evapotranspiration the yearly precipitation range is -330−-410 mm (U. S. Department of Commerce, 1962). In the Bighorn Mountains, at Burgess Junction (2,500 m), the average precipitation range increases to 510–760 mm per year and the average temperature range is -5.5–7.8 ºC (U. S. Department of Commerce, unpubl. data).

The modern distributions of Wyoming mammals are deeply influenced by the changes in elevation between the mountains and basins. Bailey's (1998) and Brown et al.'s (1998) province classification parallel Long's (1965) Wyoming mammal faunal divisions. Common mammals of the western Wyoming basins are: White-tailed Jackrabbit (*Lepus townsendii*), Wyoming Ground Squirrel (*Urocitellus elegans*), White-tailed Prairie Dog (*Cynomys leucurus*), and Ord's Kangaroo Rat (*Dipodomys ordii*). Mammals largely restricted to the mountain ranges are: Pika (*Ochotona princeps*), Snowshoe Hare (*Lepus americanus*), and Yellow-Bellied Marmot (*Marmota flaviventris*). The most commonly observed species at Natural Trap Cave occur in both or only in the basin: Desert Cottontail (*Sylvilagus audubonii*), Least Chipmunk (*Tamias minimus*), and Bushy-tailed Woodrat (*Neotoma cinerea*) (pers. observation). Chomko and Gilbert (1987) list a number of other species trapped or observed near Natural Trap Cave that inhabit both faunal subdivisions or only the alpine subdivision: Masked Shrew (*Sorex cinereus*), Meadow Vole (*Microtus pennsylvanicus*), Northern Pocket Gopher (*Thomomys talpoides*), Deer

Mouse (*Peromyscus maniculatus*). No mammalian species are endemic to the basins or mountain ranges although there are multiple examples of endemic subspecies (Long, 1965).

Natural Trap Cave is in the upper most Madison Limestone (Mississippian), a unit that is responsible for much of the topographic relief in the western Bighorn Mountain foothills. The Madison Limestone is approximately 190 m thick at Natural Trap Cave and consists of interbedded limestone and dolomite members (Denson and Morrisey, 1952; Strickland, 1956). The Madison was subjected to weathering in the Mississippian and again during the Tertiary, which resulted in prominent karst topography where it is exposed on Little Mountain (Sando et al., 1975). The Horseshoe Shale member of the Amsden formation overlies the Madison Limestone on Little Mountain, forming low, rounded hills (Sando et al., 1975).

Natural Trap Cave is a breached cave that was probably opened during the Pleistocene and was subsequently enlarged by water runoff through the entrance (Albanese, unpubl. data). The Natural Trap Cave entrance at 4.6 m wide is easily hidden from view by high points in the limestone surrounding the horizontal entrance. The pear-shaped main chamber, approximately 30 m in maximum diameter, is 26 m below the entrance (Fig. 2). The surface dips gently to the north, with a slight depression located immediately under the main entrance. There is plentiful evidence that water was the primary agent in the deposition of the sediments within the cave. In various parts of the cave, there are sediment banding, gravel lenses, and erosional surfaces. The silt and clay fractions of the Natural Trap Cave sediment are composed primarily of quartz, orthoclase, and plagioclase; material commonly found in the Amsden Formation, but not in the Madison (Albanese, unpubl. data). Limestone roof fall is present in varying sizes in every stratum, indicating that the cave roof has been changing throughout.

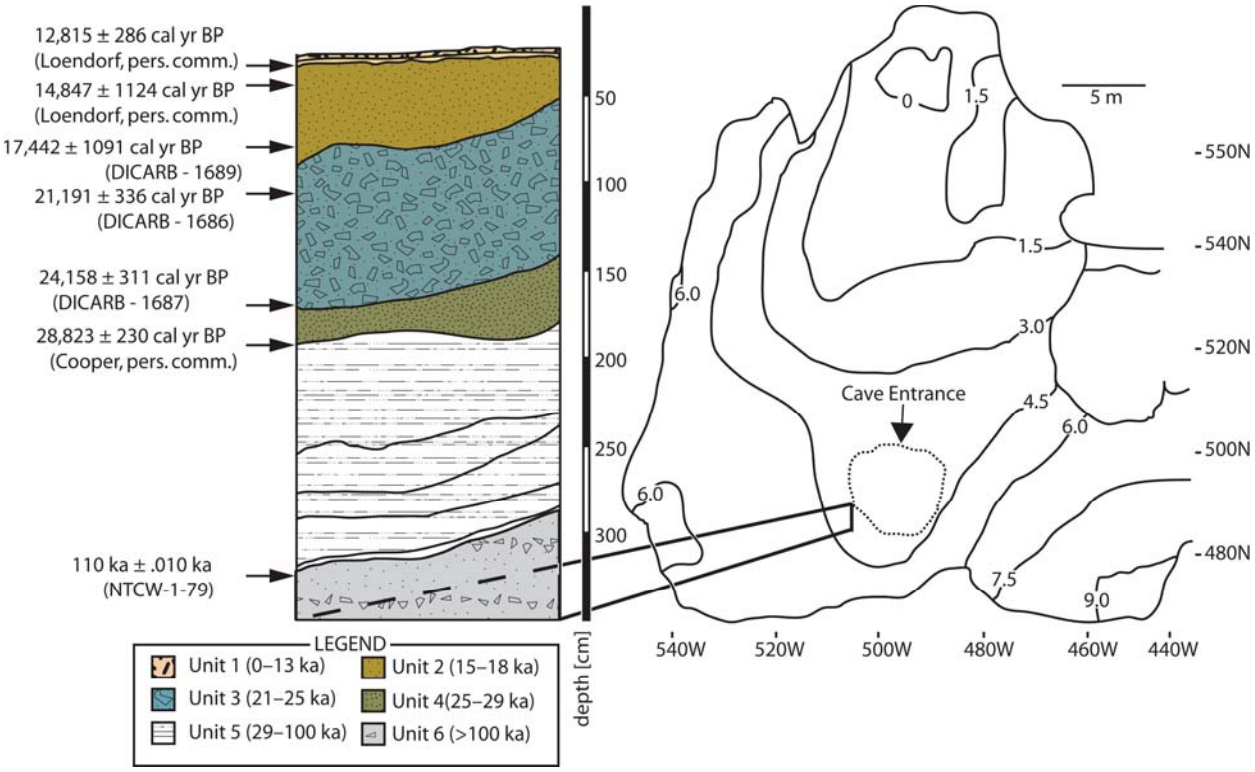


Figure 2. Generalized stratigraphy and plan view of the main floor of Natural Trap Cave. Contour interval is 1.5 m. Stratigraphic section at left is the eastern wall of quadrat 495NW510. The plan view coordinate system reflects the original quadrat system described in Martin and Gilbert (1978).

Excavation in Natural Trap Cave began with Rushin's (1973) initial test excavation, which identified 20 mammal and five bird taxa to varying taxonomic levels. Excavation was limited to a 1.5m^2 square area to a depth of 1.9m. Later work by Martin and Gilbert (1978) were done using an archaeological random-squares grid with quadrats of varying size excavated in depth intervals of 15cm. In each interval one or two 142m^3 samples of matrix were saved for screening and the largest proportion of the microfauna came from these blocks (Martin and Gilbert, 1978).

The Natural Trap Cave stratigraphic column was divided into six units by Martin and Gilbert (1978), numbered in descending order from the room's surface (Figs. 2, 3). Unit 1 is

thin, tan calcareous silt partially formed from the weathering of limestone fall from the cave ceiling (Albanese, unpubl. data). Radiocarbon dating suggest this unit was deposited primarily during the Holocene and latest Pleistocene (13–0 ka). Unit 2 is composed of maroon-green silt with an increased amount of limestone roof fall, often localized into lenses of limestone gravel. Unit 2 was deposited during the end of the LGM and the beginning of the deglaciation (18–15 ka). The contact between Units 2 and 3 is marked in the southwestern section of the cave by a channel of cross-bedded sands and silt oriented NW–SE (Fig. 3). Unit 3 is gray-green massive silt with areas of brown limonitic staining, indicating repeated water saturation (Albanese, unpubl. data). Extensive radiocarbon bone dating in this unit confirms deposition from 25–21 ka (Table 1). Albanese (unpubl. data) described Unit 4 as olive-green clayey silt beneath Unit 3, which radiocarbon dating indicates was deposited 29–25 ka. Albanese (unpubl. data) and Martin and Gilbert (1978) recognized at least three additional stratigraphic units below Unit 4, which are combined here as Unit 5 due to a lack of age control and a limited fauna that is similar to the Unit 4 fauna in composition and abundance.

A volcanic ash forms the contact between Unit 5 and Unit 6, which was excavated in the main room immediately below and south of the cave entrance (Figs. 2, 3). Unit 5 is fine gray sand with two separate volcanic ashes located beneath the ash forming the contact between Units 4 and 5. The uppermost of these ashes was fission-track dated to 110 ± 10 kyr YBP (Gilbert et al., 1980). Izett (1981) found further support for a >100 kyr age in the rare earth element composition of the Natural Trap Cave ash, which is similar to other Yellowstone ashes. Izett (1981) was able to correlate the Natural Trap Cave ash to a tephra sampled from Yellowstone Lake that was K-Ar dated at about 150,000 years. The fauna from below the volcanic ash was

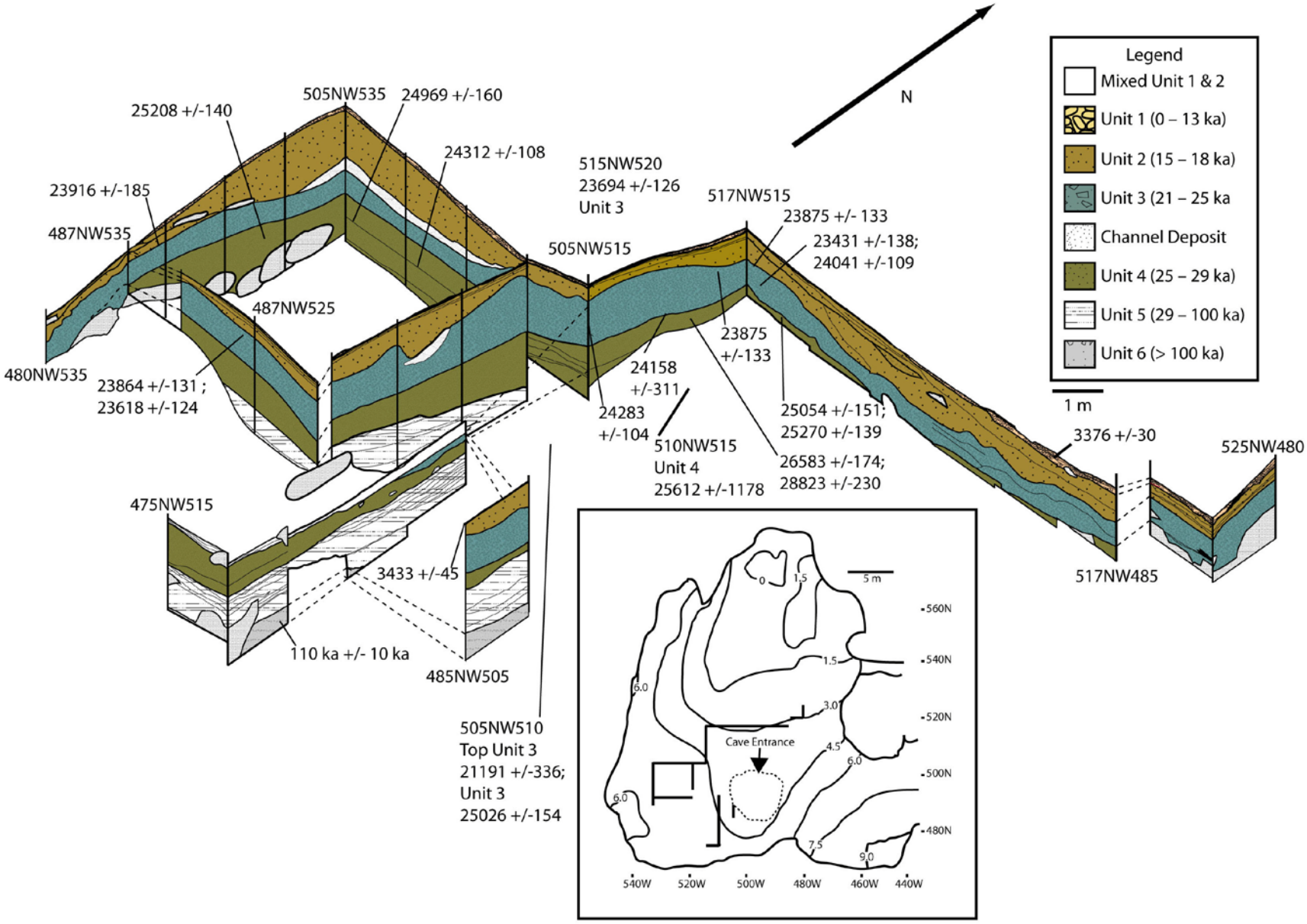

N
Legend
Mixed Unit 1 & 2
Unit 1 (0 – 13 ka)
Unit 2 (15 – 18 ka)
Unit 3 (21 – 25 ka
Channel Deposit
Unit 4 (25 – 29 ka)
Unit 5 (29 – 100 ka)
Unit 6 (> 100 ka)
1 m
505NW535
24969 +/-160
25208 +/-140
24312 +/-108
23916 +/-185
487NW535
515NW520
23694 +/-126
Unit 3
517NW515
23875 +/- 133
23431 +/-138;
24041 +/-109
505NW515
487NW525
23875
+/-133
480NW535
23864 +/-131 ;
23618 +/-124
24158
+/-311
24283
+/-104
510NW515
Unit 4
25612 +/-1178
25054 +/-151;
25270 +/-139
26583 +/-174;
28823 +/-230
3376 +/-30
525NW480
475NW515
3433 +/-45
110 ka +/- 10 ka
485NW505
517NW485
505NW510
Top Unit 3
21191 +/-336;
Unit 3
25026 +/-154
5 m
Cave Entrance
560N
540N
520N
500N
480N
540W
520W
500W
480W
460W
440W

Figure 3. Natural Trap Cave fence diagram showing the portion of the stratigraphic column correlated with the radiocarbon and ash date chronology. Ages are cal yr BP from Table 1. Inset at right show the location of the fence sections in the main room.

radiocarbon dated (Weinstock et al., 2005; Cooper, pers. comm.). However, radiocarbon dating from these levels disagrees with the fission-track volcanic ash date; Weinstock et al. (2005) and Cooper (pers. comm.) both dated horse (*Equus*) bones from beneath the volcanic ash at 27,410 ± 200 and 47,200 ± 1400 ^{14}C yr B.P., respectively. Wang (pers. comm.) has done further radiocarbon dating using the ash-related fauna finding infinite dates, and suggested that very small levels of contamination in old carbon specimens could result in finite dates in specimens that should be infinite.

Lab no.	KUVP no.	Taxonomic ID	Square	Unit	^{14}C date	std dev	cal yr BP	std dev
OxA-11271	42887	*Bison*	485NW505	Unit 1	3220	45	3433	45
OxA-11169	44361	*Bison*	520NW490	Unit 1	3155	36	3376	30
OxA-12124	51275	*Bison*	505NW515	Unit 3	20380	90	24283	104
Cooper (pers. comm.)	47238	*Equus*	505NW530	Unit 3	20410	90	24312	108
Cooper (pers. comm.)	43503	*Equus*	500NW535	Unit 3	21060	90	25208	140
Cooper (pers. comm.)	32589	*Equus*	495NW530	Unit 3	19970	90	23864	131
Cooper (pers. comm.)	43093	*Miracinonyx*	495NW530	Unit 3	19765	80	23618	124
Cooper (pers. comm.)	44409	*Panthera*	517NW515	Unit 4	24080	170	28823	230
Cooper (pers. comm.)	47519	*Equus*	505NW535	Unit 3	20880	90	24969	160
Cooper (pers. comm.)	47682	*Equus*	515NW520	Unit 3	19830	80	23694	126
Cooper (pers. comm.)	48226	*Equus*	517NW515	Unit 3	19980	90	23875	133

Cooper (pers. comm.)	50438	*Equus*	520NW515	Unit 3	21110	90	25270	139
Cooper (pers. comm.)	51275	*Bison*	505NW515	Unit 3	20380	90	24283	104
Cooper (pers. comm.)	53042	*Equus*	520NW515	Unit 3	20130	80	24041	109
Cooper (pers. comm.)	53503	*Equus*	520NW515	Unit 3	19980	90	23875	133
Cooper (pers. comm.)	53885	*Equus*	520NW515	Unit 3	19610	80	23431	138
Cooper (pers. comm.)	81921	*Equus*	501NW510	Unit 3	20920	90	25026	154
Loendorf (pers. comm.)				Unit 2	12770	900	14847	1124
Loendorf (pers. comm.)				Unit 1	10930	300	12815	286
Dicarb-689				Unit 2	14670	670–730	17442	1091
Dicarb-690				Unit 3	17620	1490–1820	20983	2195
Dicarb-878		Bird feces	HWS		1400	60	1307	38
Dicarb-1686		*Equus*	505NW510	Unit 3	17870	230	21191	336
Dicarb-1687		bone	510NW515/505	Unit 3	20250	275	24158	311
Dicarb-1689		*Equus*	510NW515	Unit4	21370	920	25612	1178

Table 1. Radiocarbon dates for Natural Trap Cave and Hole-in-the-Wall Shelter (HWS). The Radiocarbon calibrated dates used the Fairbanks et al. (2005) calibration curve.

The fission-track dated volcanic ash places the Unit 6 fauna at the end of the 'Sangamonian' interglacial period (Marine Oxygen Isotope Stage 5e; ~130–115 kyr BP). The relatively warm 'Sangamonian,' from this point forth referred to as the Last Interglacial (LIG), was followed by two short (~20 ka) glacial advances (MIS 5b and d) and retreats (MIS 5a and c) (Andrews and Dyke, 2007). The Wisconsinan glaciation began in earnest during MIS 4, ~75kyr BP (Andrews and Dyke, 2007).

Prospects Shelter, Eagle Shelter, Juniper Cave, and Hole-in-the-Wall Shelter (HWS) are all formed in the upper Madison Limestone. The first three are located in the canyon next to NTC and HWS is located on the western valley wall of Devil's Canyon. Juniper Cave is the largest of the three, sloping gently up from the entrance 20 m before ending in massive limestone rock fall (Kelly et al., 2002). Kelly et al. (2002) sampled three quadrats within Juniper Cave and established a chronology using radiocarbon dating, noting an apparent disconformity between the bottom of a hearth dated to 8,440 ^{14}C yr B.P. and a layer of *Ovis* feces ~10 cm beneath the hearth dated to >26,460 ^{14}C yr B.P. Most of the fauna was therefore deposited during the Holocene and during the middle of the Wisconsinan Glacial Age with the intervening deposits removed, possibly through trampling by Bighorn Sheep (*Ovis canadensis*) (Kelly et al., 2002). Prospects Shelter is smaller than Juniper Cave, ~13.5 m deep from the drip line, but preserves a more complete stratigraphic record of the last glacial maximum. Chomko and Gilbert (1987) recognized two strata, III and IV, within Prospects Shelter that were dated using bone thermoluminescence at 13–10 kyr and 27–13 kyr. Finley (2008) dated Prospects shelter again using OSL (Optically Stimulated Luminescence) samples taken from a fresh sediment profile. The OSL dates indicate the previous thermoluminescence dates are too young as well as too restricted in range. The new range for stratum IV encompasses most of the Wisconsinan (89–18 ka)(Finley, 2008). Eagle Shelter is similar in area to Prospects Shelter, although it is located much closer to the valley floor than Prospects Shelter. The sediments in Prospects Shelter and Juniper Cave are primarily aeolian deposits, whereas Eagle Shelter's deposits are formed from alluvium derived from the talus slopes on either side of the entrance (Chomko, 1982). Chomko and Gilbert (1987) described the shelter record as encompassing most of the Holocene based on artifacts near the deposit's bottom culturally dated to >8,500 yr BP. HWS is a small rockshelter

that contains a raptor roost on the rear wall that had a large pile of feces and pellets (~80 cm in height, 120 cm in diameter). Radiocarbon dating of avian feces from the bottom of the pile indicated deposition during the late Holocene (1307 ±38 cal yr B.P.).

Wang and Martin (1993) described the taphonomy and sampling of the large mammal fauna of Natural Trap Cave. For the large mammals the cave acted as a pit-trap, which can be seen in the lack of predator bone modification and the absence of another accessible entrance. For some of the small mammals the same may also be true, but packrats (*Neotoma sp.*) also seem to have played a role. The presence of *Neotoma sp.* fossils throughout the sequence, incisor-gnawed bones, and midden debris in the upper level indicate that *Neotoma* introduced at least some of the fossils into the cave (Chomko and Gilbert, 1987). The presence of packrats is important because these animals often collect predator scat, which may sample from multiple habitats. Evidence of such sampling is shown by the fish and waterfowl found in the cave.

Natural Trap Cave floral studies describe the pollen, phytolith, and packrat midden paleobotanical records in and surrounding the cave. Pearsall (Gilbert et al., 1980) presented the major features of the phytolith record from the cave showing a period of relative stability in the grass community before 21 kyr, followed by shifting concentrations between the Panicoid, Festucoid, and Chloridoid grasses through the Last Glacial Maximum and then relative stability from 12–10 kyr. Johnson and Fredlund (1982) found well-preserved pollen in sediment samples at each previously dated stratum in the cave, and documented some change in the regional flora. Wells (1983) collected packrat middens from the canyon below the cave and published the results from three middens dated at 27, >30, and >40 ^{14}C yr B.P. Spruce (*Picea engelmannii*) and juniper (*Juniperus communis*) occur in low frequencies, while the collection is dominated by limber pine (*Pinus flexilis*).

Objectives

Natural Trap Cave offers a unique opportunity to test for the effects of biogeography and species habitat specificity on faunal stasis. First, I fully describe the systematics of the Natural Trap Cave small mammal fauna (<5 kg) followed by the faunal taphonomy. Next, the Little Mountain faunal record (Natural Trap Cave and the nearby rockshelters) is used to test for paleocommunity stasis at the local and regional scales. Significant stasis was found at both levels, which I attributed primarily to species habitat generality and east-west geographic barriers.

CHAPTER 2

Systematic description and additions to the Natural Trap Cave small mammal fauna

The small mammal fauna from Natural Trap Cave is described in a series of preliminary reports. Martin and Gilbert (1978), Chomko and Gilbert (1980), Chomko (1984), Gilbert and Martin (1984), and Chomko and Gilbert (1987) discussed the Holocene and Wisconsin glacial age small mammal faunas from Natural Trap Cave. Chomko and Gilbert (1980), Chomko (1984), and Chomko and Gilbert (1987) presented preliminary reports on the biostratigraphy within the cave based on a small initial sample. The Wisconsin glacial age fauna was noted for possessing the arctic tundra taxa Arctic Hare (*Lepus* cf. *arcticus*) and Collared Lemming (*Dicrostonyx groenlandicus*) (Martin et al., 1979; Chomko and Gilbert, 1987). Chorn et al. (1988) and Martin and Kadivar (2003) reported a preliminary faunal list from the Natural Trap Cave Last Interglacial (LIG) strata: Pygmy Rabbit (*Brachylagus idahoensis*), Black-tailed Jackrabbit (*Lepus californicus*), a cricetine rodent, three sciurid taxa, woodrat (*Neotoma*), an arvicoline rodent, and a soricid shrew.

There are no other known LIG faunas (~125–75 ka) in Wyoming (Pinsof, 1996). The closest LIG locality to Natural Trap Cave is the Doeden fauna in southeastern Montana, which is a collection of mammalian megafauna from a gravel pit located on the Yellowstone River (Wilson and Hill, 2000). The American Falls fauna, ID and Silver Creek fauna, UT are both from LIG-correlated alluvial deposits and do include small mammals (Miller, 1976; Pinsof, 1992). Thus, Natural Trap Cave fills an important geographic gap in the small mammal record during the LIG between sites in the central Rocky Mountains and the northern Great Plains.

Herein, I reported several new additions to the Natural Trap Cave fauna including the shrews *Sorex hoyi* and *S. nanus* and the bats *Lasiurus cinereus* and *Antrozous pallidus*. New

materials of previously reported taxa are described here also, which resulted in a more homogeneous fauna through time within Natural Trap Cave than described originally.

The objectives of this analysis are to describe new additions to the fauna and to compare the LIG fauna with other faunas from surrounding regions. Natural Trap Cave has the only LIG small mammal record for the Bighorn Mountains and because of its unique geographic location samples several taxa not shared with other contemporaneous sites.

Materials and Methods

Identification

This revision of the Natural Trap Cave fauna is based on a collection of 2,523 individual specimens. All specimen identifications were based on extensive comparisons with modern material from the region deposited in the KUM (University of Kansas Mammalogy) and UWBM (University of Washington Burke Museum) recent mammal collections. Additional morphometric work was required to make identifications to genus and species for the leporids, marmots (*Marmota*), western chipmunks [*Tamias* (*Neotamias*)], small cricetine mice (*Peromyscus/Reithrodontomys*), and voles (*Microtus*).

I followed the morphometric method of Ramos (1999) to make the leporid identifications. First, each mandible with a p3 was classified based on the following p3 patterns: no anterior reentrant, posterior external reentrant divides tooth into anterior and posterior sections (*Brachylagus idahoensis*); <3.3 mm length with crenulation in reentrants, posterior external reentrant does not divide tooth (*Sylvilagus* spp.); >3 mm length with little crenulation in posterior external reentrant (*Lepus americanus*, *L. arcticus*, *L. townsendii*); >3.5 mm length with increased crenulation in reentrants (*L. alleni*, *L. californicus*). Then, each mandible was measured with Marathon digital calipers for the following possible variables: depth of mandible from anterior alveolar notch of p4, length and width of p3, width of p4, width of m1, width of m2, and width of m3. Finally, I compared each fossil mandible with the mandibular measurement data compiled by Ramos (1999) for the corresponding p3 class.

Due to morphological overlap between *L. townsendii* and *L. arcticus*, the curvature of the I1 is considered necessary to substantiate identifications of *L. arcticus* (Ramos, pers. comm.). I measured all available *Lepus* premaxillas with associated incisors for incisor curvature and

photographed the labial side of each specimen, then imported the data to tpsDig2, a morphometrics software package (Rohlf, 2006). The angle of curvature was measured at the dorsal-most extension of the incisor along the inner edge of the tooth.

I performed a landmark analysis to identify the NTC marmot dentaries to species using the locations of the dentary morphological landmarks taken from Caumul and Polly (2005). The modern marmots included for comparison were Woodchuck (*Marmota monax*), Yellow-bellied Marmot (*M. flaviventris*), and Hoary Marmot (*M. caligata*). The landmarks were applied to photographs of the labial side of each specimen in tpsDig2, which translated the landmarks into cartesian coordinates (Rohlf, 2006), then PAST (PAleontological STatistics) was used to transform them into Bookstein Coordinates (Hammer et al., 2001). Each Bookstein Coordinate, which essentially standardizes for size, was then treated as two separate variables (x and y), for a total of 26, in a discriminant function analysis using the MINITAB statistics software package.

To identify the chipmunks (*Tamias*), small cricetines (*Peromyscus*/*Reithrodontomys*), and pocket mice (*Perognathus*) to species, I compared them to modern Wyoming specimens using maxilla and dentary tooth row length measurements. Tooth row length was measured using a Carl Zeiss ocular micrometer mounted on a dissecting microscope.

I used the landmark method of Wallace (2006) to identify *Microtus* m1's with five closed triangles to species. A Nikon SMZ 1000 binocular microscope fitted with a Nikon DXM 1200 digital camera and ACT-1 Image Platform System was used to photograph an m1 occlusal view from samples of five-triangle vole species that currently occur in Wyoming or have been reported in nearby regions during the Pleistocene: *Microtus longicaudus*, *M. miurus*, *M. montanus*, *M. pennsylvanicus*, *M. richardsoni*, and *M. xanthognathus.* tpsDig2 was then used to

encode 21 cartesian coordinate landmarks for each m1 (Rohlf, 2006), which were then transformed into Bookstein Coordinates and analyzed in a manner similar to the marmots.

Faunal comparisons

The Natural Trap Cave Last Interglacial (LIG) fauna was compared with seven other faunas that date to the LIG: American Falls, ID; Silver Creek, UT; Mesa de Maya, CO; Jinglebob and Cragin quarry (KS); Riddell (SK); Medicine Hat #7 (AB) (reviewed in Pinsof, 1996).

SYSTEMATIC PALEONTOLOGY

SORICIDAE Fischer de Waldheim, 1817

SOREX SP. Linnaeus, 1758

Referred Material—1 partial skull (KUVP 141891); 4 R, 2 L dentaries (KUVP 147084, 147945, 148820, 148821, 148822, 148827).

Description—Small shrew, skull with incomplete jugal arches, dilambdodont molars, anterior teeth in jaw pigmented red, slim dentary with a tall triangular-shaped coronoid process.

Comments—These specimens lack the i1 alveolus that is necessary to distinguish species (Carraway, 1995). They clearly represent a very small soricid, similar in size to *Sorex nanus* or *S. hoyi*. KUVP 148820 and 148821 have low coronoid process height, 2.56 and 2.63 mm, respectively. *S. nanus* is the only shrew in North America with a comparable coronoid process height (Carraway, 1995), so KUVP 148820 and 148821 are probably referable to that taxon.

SOREX HOYI Baird, 1858

Referred Material—1 partial skull with dentaries (KUVP 64690); 5 R, 5 L dentaries (KUVP 141890, 141892, 147940, 147943, 147946, 148823, 148824, 148825, 148826, 148828).

Description—Alveoli for P2–P4 very closely compressed, in labial view alveolus of i1 extends posteriorly beneath the paraconid of m1, temporal fossa composed of an triangular opening leading directly into a superior depression.

Comments—The Pygmy Shrew's (*Sorex hoyi*) usual habitat is alpine bogs and adjoining dry areas (Long, 1974). Within Wyoming, *S. hoyi* is present only in Yellowstone and Teton National Parks and the Medicine Bow mountain range today (Hall, 1981). Pleistocene/Holocene

reports of *S. hoyi* from Wyoming's Little Box Elder Cave and Lamar Cave are located near the limits of the modern range. Natural Trap Cave is the first record in the Bighorn Mountains for this taxon. Within Natural Trap Cave, it was present in Units 1, 2, and 6 (13–0, 18–15, and >100 ka).

SOREX NANUS Merriam, 1895

Referred Material—1 articulated left and right dentaries (KUVP 147942); 1 R, 2 L dentaries (KUVP 147941, 147944, 147947).

Description—In labial view, alveolus of i1 does not extend posteriorly beneath the paraconid of m1, dentary below m1 shallower than height of m1, length of c1-m3 < 4.1mm, height of coronoid process ≤ 3.2 mm.

Comments—The Dwarf Shrew (*Sorex nanus*) is a rare shrew in Wyoming fossil localities from the Pleistocene, although it occurs throughout Wyoming today (Long, 1965). *S. nanus* has been reported from Pleistocene/Holocene sediments in Shield Trap in the Pryor Mountains immediately north of Natural Trap Cave in Montana (Bonnichsen et al., 1986). Within Natural Trap Cave it was found in Unit 6 (>100 ka).

VESPERTILIONIDAE Gray, 1821

MYOTIS SP. Kaup, 1829

Referred Material—1 partial skull (KUVP 68250), 1 R maxilla (KUVP 148391), 1 R dentary (KUVP 148392).

Description—Premaxillas separated anteriorly, palate terminates well behind M3, and tooth formula I2/3, P3/3.

Comments—These two specimens compared well with *Myotis lucifugus* in overall size. Vespertilionid postcranial elements that are similar in size to this small *Myotis* are present also in Units 1, 2, 4, 5, and 6 (13–0, 18–15, 29–25, 100–35, and >100 ka).

LASIURUS CINEREUS Palisot de Beauvois, 1796

Referred Material—1 R femur (KUVP 148355).

Description—Spherical head, greater trochanter is slightly smaller than the lesser trochanter, larger than *Lasiurus borealis*.

Comments—KUVP 148355 was compared to samples of Eastern Red Bat (*Lasiurus borealis*) and Hoary Bat (*Lasiurus cinereus*) and was more similar in size (21.83 mm) to Hoary Bat (mean = 23.17 mm, n = 5) than Eastern Red Bat (mean = 17.09 mm, n = 5). Therefore, I refer it to the larger *L. cinereus*. This taxon was only found in Unit 1 (13–0 ka).

ANTROZOUS PALLIDUS Le Conte, 1856

Referred Material—1 left and right articulated dentaries (KUVP 64678); 1 R, 1 L dentaries (KUVP 64800, 147110; 1 R m3 (KUVP 148389).

Description—Very large size, 2 lower incisors, reduced m3 talonid, high coronoid process.

Comments—The Pallid Bat (*Antrozous pallidus*) is found in arid habitats of the American southwest today, ranging from Mexico to Washington (Hermanson and O'Shea, 1983). In Wyoming, the Pallid Bat is only found in the southeast and southwest portions of the state, it does not occur in the Bighorn Mountains (Durrant and Dean, 1960; Stromberg, 1982). Within Natural Trap Cave, *A. pallidus* was found in Unit 2 (18–15 ka) and Unit 1 (13–0 ka). The nearest fossil occurrence to Natural Trap Cave is in the Holocene of Hogup Cave, located in northwestern Utah, which is also extralimital for the taxon (Hall, 1981; FAUNMAP, 1994).

OCHOTONIDAE Thomas, 1897

OCHOTONA SP. Link, 1795

Referred Material—1 R dentary (KUVP 64763; right p3 (KUVP 148853); indeterminate molar (KUVP 148855); 1 L maxilla (KUVP 97672); 2 R, 1 L P4 (KUVP 148469, 148850, 148854); 2 R, 2 L M1 or M2 (KUVP 148846, 148848, 148849, 148851); 1 R, 1 L M3 (KUVP 148852, 148847).

Description—Small lagomorph, dental formula I2/1 C0/0 P3/2 M2/3, anterior loph of p2 not as wide as posterior loph, m3 with a singe loph.

Comments—The Natural Trap Cave Pika (*Ochotona*) sample is not large enough and the too fragmentary to make a specific assignment. Smith and Weston (1990) used the auditory bulla length to differentiate *Ochotona princeps* from *O. collaris*. Mead et al. (2004) suggested that a morphometric analysis of a large sample is necessary for identification. A modern population of the American Pika (*Ochotona princeps*) exists 30 km SE of Natural Trap Cave at Medicine Wheel, which however is 1400 m higher in elevation (Long, 1965). Thus, based on biogeography, the Natural Trap Cave pika and should probably be referred to *O. princeps*. Within Natural Trap Cave, *Ochotona* is known from Units 2, 3, and 4 (18–15, 25–21, 29–25 ka).

LEPORIDAE Fischer de Waldheims, 1817

BRACHYLAGUS IDAHOENSIS Merriam, 1891

Referred Material—2 R maxillae (KUVP 47408, 147864).

Description—Leporid smaller than *Sylvilagus*, first upper premolar with one reentrant angle.

Comments—The primary modern distribution of the Pygmy Rabbit (*Brachylagus idahoensis*) is in Idaho and Montana where it occurs in sagebrush-dominated habitats (Green and

Flinders, 1980). *B. idahoensis* is known from several Pleistocene sites in Idaho located within its modern distribution: Duck Point, Jaguar Cave, Owl Cave, and Rainbow Beach (FAUNMAP, 1994). Natural Trap Cave is the only extralimital Pleistocene locality for *B. idahoensis* however, which represents an unknown dispersal event for this taxon during the last interglacial age. Within Natural Trap Cave, *B. idahoensis* is known from the Units 4 and 6 (29–25, >100 ka).

SYLVILAGUS SP. Gray, 1867

Referred Material—refer to Appendix 1.3. NISP = 425.

Description—Small leporids, p3 with crenulation in anterior external reentrant and less than 3.3 mm in length.

Comments—Most Natural Trap Cave cottontail rabbits (*Sylvilagus*) are comparable in size to *Sylvilagus audubonii* and *nuttallii*.

SYLVILAGUS AUDUBONII Baird, 1857

Referred Material—Partial skull lacking nasals and bone posterior to orbit (KUVP 64816).

Description—Cottontail with anterior extension of supraorbital process, posterior extension of supraorbital process mostly free from skull, maxilla tooth row length longer than *Sylvilagus bachmani*.

Comments—The modern habitat of the Desert Cottontail (*Sylvilagus audubonii*) is arid woodlands, grasslands, and deserts at lower elevations (<1829 m) in western North America (Chapman and Willner, 1978). It is relatively common in the arid grasslands surrounding Natural Trap Cave today (pers. observation). KUVP 64816 is from a quadrat within Natural Trap Cave that cannot be correlated with the dated units, so an age cannot be assigned to it. The skull was recovered <77 cm from the surface however, similar in relative depth to Units 1 and 2

in other areas of the cave, so it is probably no older than 18 ka. Other Wyoming localities that include *S. audubonii*, all Holocene in age, include Lamar Cave, River Bend, Vore, and Wortham Shelter (FAUNMAP, 1994).

LEPUS SP. Linnaeus, 1758

Referred Material—refer to Appendix 1.3. NISP = 75.

Description—Large leporid, supraorbital process broadly triangular and winglike, maxillae tooth row length > ~15 mm; p3 >3.3 mm length, p3 with no crenulation in reentrant angles.

Comments—All p3's are similar in size (mean = 3.73 mm) to *Lepus townsendii* (mean=3.86 mm) (Ramos, 1999).

LEPUS ARCTICUS Ross, 1819

Referred Material—1 L premaxilla; 1 L dentary (KUVP 36786, 67908).

Description—p3 >3.3mm in length with little to no crenulation in posterior external reentrant; larger than *Lepus townsendii* and *L. americanus*, especially deeper dentary below p4; I1 with >110 degree curvature as measured from middle of tooth length, smooth confluence of premaxilla and I1.

Comments—The Arctic Hare (*Lepus arcticus*) is found today in the arctic tundra of Canada (Hall, 1981). *L. arcticus* is one of the largest hares in North America with an uncrenulated p3 and a protruding upper incisor for feeding on small arctic plants buried in snow (Bittner and Rongstad, 1982; Ramos, 1999). KUVP 36786 has a procumbent incisor (114.1°) similar to that observed in modern *L. arcticus.* *L. arcticus* is not known south of the Northwest

Territories in Canada and Alaska during the Pleistocene (Kurtén and Anderson, 1980; Bittner and Rongstad, 1982; Driver, 1988). Within Natural Trap Cave, *L. arcticus* is known from Units 2 and 3 (18–15, 25–21 ka).

LEPUS CALIFORNICUS Gray, 1837

Referred Material—1 R, 1 L p3 (KUVP 97117, 147936)

Description—p3 greater than 3.3 mm in length with crenulation in posterior external reentrant.

Comments—These specimens have crenulated anterior external reentrants, although to different degrees (Fig. 3). This is a character of the Antelope Jackrabbit (*Lepus alleni*) and the Black-tailed Jackrabbit (*L. californicus*). *L. californicus* has a mean p3 length (3.95 mm) more comparable to these specimens (3.82 mm, 3.38 mm) than the larger *L. alleni*. Modern *L. californicus* does not occur today in the Bighorn Mountains; the nearest occurrence is to the south near Laramie, WY and to the west in Idaho (Hall, 1981). *L. californicus* is known from the Holocene of Middle Butte and Moonshiner caves, and the Wisconsin of Wilson Butte Cave in Idaho (FAUNMAP, 1994). *L. californicus* is known from Unit 1 (13–0 ka) within Natural Trap Cave.

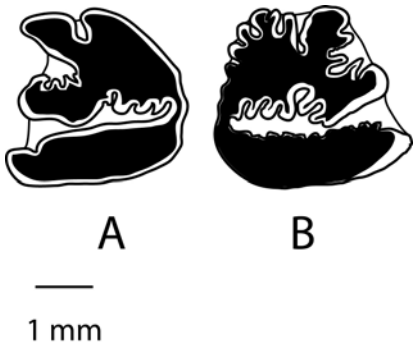


Figure 4. Occlusal view of p3's referred to *Lepus californicus.* (A) left p3, KUVP 97117; (B) right p3 KUVP 147936.

SCIURIDAE Fischer de Waldheim, 1817

TAMIAS (*NEOTAMIAS*) SP. A. H. Howell, 1929

Referred Material—refer to Appendix 1.4. NISP = 130.

Description—Small sciurid, infraorbital foramen pierces the zygomatic plate, mesiobuccal notch present on m1–m3, premolars 2/1.

Comments—These specimens were too incomplete to obtain the measurements for comparison with other Wyoming chipmunks or fall in the size overlap present among all modern species examined.

TAMIAS MINIMUS Bachman, 1839

Referred Material—refer to Appendix 1.4. NISP = 15.

Description—Odontometrically the smallest chipmunk in Wyoming.

Comments—Identification of *Tamias* species in fossil contexts is difficult because qualitative characters are not useful, so a quantitative approach using dental measurement has been used most often (e.g. Goodwin and Reynolds, 1989; Goodwin, 2004). Size comparisons of dentary and maxilla tooth row lengths were made with three other chipmunk species that occur in northern Wyoming today, the Least Chipmunk (*Tamias minimus*), the Yellow-pine Chipmunk (*T. amoenus*), and the Uinta Chipmunk (*T. umbrinus*) (Fig. 4). *T. minimus* is the only chipmunk that occurs now in the Big Horn Mountains, but *T. umbrinus* and *T. amoenus* occur nearby to the west in the Absaroka Mountains (Long, 1965).

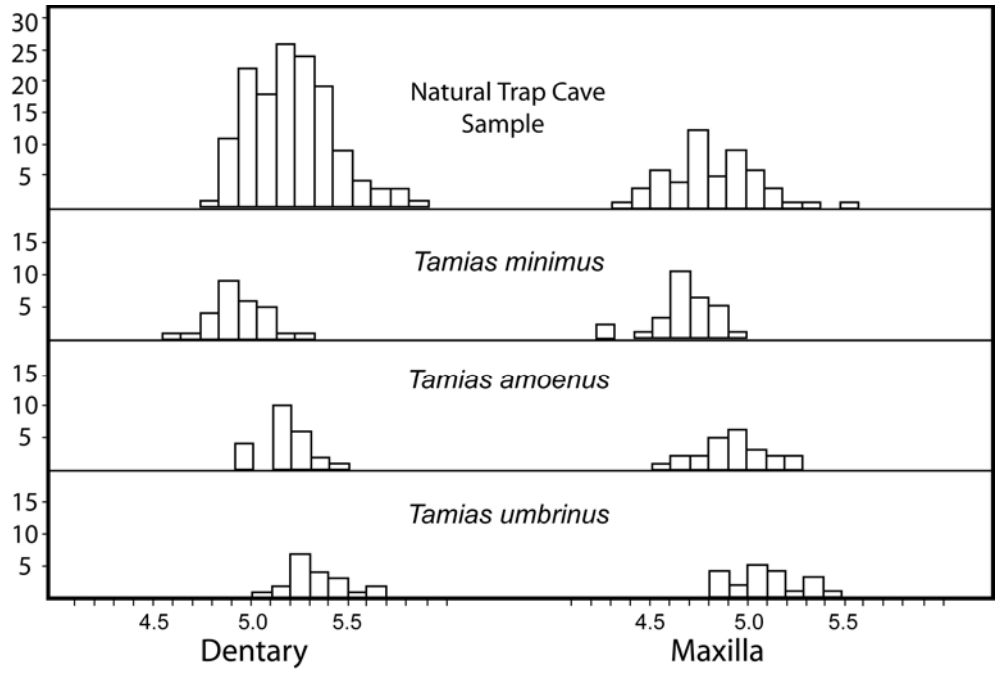


Figure 5. Histogram of dentary and maxilla occlusal length measurements from Natural Trap Cave *Tamias* and from three modern *Tamias* species from NW Wyoming.

The smallest specimens in Natural Trap Cave are comparable to *T. minimus* in size (Fig. 4). Specimens referable to *T. minimus* are present in the Pleistocene levels, predominantly in the LIG Unit 6, and absent in Unit 1 (13–0 ka). Other small chipmunks described below that are possibly referable to *T. minimus* are present in Unit 1.

TAMIAS sp. small

Referred Material—refer to Appendix 1.4. NISP = 40.

Description—Size overlapping ranges of *Tamias amoenus* and *T. minimus*.

Comments—Based on size comparisons, these specimens could be either *Tamias minimus* or *T. amoenus* (Fig. 4). The nearest modern population of *T. amoenus* is ~100 km west in the Absaroka Mountains (Long, 1965). This morphotype is present in all stratigraphic levels within Natural Trap Cave except Unit 3.

TAMIAS sp. intermediate

Referred Material—refer to Appendix 1.4. NISP = 33.

Description—Size overlapping ranges of *Tamias amoenus* and *T. umbrinus*.

Comments—These specimens could be either *Tamias amoenus* or *T. umbrinus* (Fig. 4). The nearest modern population for both *T. amoenus* and *T. umbrinus* is ~100 km west in the Absaroka mountain range (Long, 1965). This morphotype is present in Units 1, 2, 3, and 6 (13–0, 18–15, 25–21, >100 ka) within Natural Trap Cave.

TAMIAS sp. large

Referred Material—refer to Appendix 1.4. NISP = 14.

Description—Large *Tamias* exceeding the upper limits of the size range of *T. amoenus*.

Comments—These specimens exceed the observed size range of *Tamias minimus* and *T. amoenus* and are comparable in size to *T. umbrinus* (Fig. 4). The nearest modern population of *T. umbrinus* is ~100 km west in the Absaroka mountain range (Long, 1965). This morphotype is present in Units 1, 2, 3, and 6 (13–0, 18–15, 25–21, >100 ka) within Natural Trap Cave.

MARMOTINI Pocock, 1923

MARMOTINI, sp. 1

Referred Material—refer to Appendix 1.4. NISP = 33.

Description— Medium-sized sciurid, P3 similar in size to other upper teeth, subrectangular lower molars.

Comments—These specimens are similar in general proportions and size to Richardson's Ground Squirrel (*Urocitellus richardsonii*) and Wyoming Ground Squirrel (*U. elegans*) and therefore may be referable to those taxa. They are in any case definitely referable to one of the ground squirrel genera formerly included within the genus *Spermophilus* (*sensu lato*). Ground squirrels similar to these two taxa occur throughout Natural Trap Cave.

MARMOTA SP. Blumenbach, 1779

Referred Material—refer to Appendix 1.4. NISP = 78.

Description—Large sciurid; elongated, V-shaped, temporal arches.

Comments—Differentiating marmot (*Marmota*) species in a fossil context is difficult, there are not many useful qualitative characters, and linear quantitative characters have limited use. Use of landmark data for identification of lower jaws had limited success in a discriminant function analysis (64% jackknifed success rate). KUVP 64829 was identified as the Yellow-bellied Marmot (*M. flaviventris*) with a high probability ($p<0.05$); all others were not statistically significant. Qualitative characters suggest *M. flaviventris* and the Hoary Marmot (*M. caligata*) are more likely present than the Woodchuck (*M. monax*). The upper tooth rows of *M. flaviventris* and *M. caligata* diverge anteriorly, unlike *M. monax* (Hall, 1981). There are two maxillas (KUVP 64733 and 62399) complete enough to preserve the alignment of the upper tooth rows and both have the *M. flaviventris* and *M. caligata* character state. Furthermore, *M. flaviventris* is the most likely species present based on biogeography. Only *M. flaviventris* occurs in the Bighorn Mountains and Wyoming today. *M. caligata*'s nearest occurrence is in northern Idaho and northwestern Montana. *Marmota flaviventris* does not occur in the immediate vicinity of Natural Trap Cave today, but it is present at higher elevations around Medicine Wheel where the preferred alpine meadow habitat is present (Long, 1965). Marmots are found in every stratigraphic unit in Natural Trap Cave.

MARMOTA FLAVIVENTRIS Audubon and Bachman, 1841

Referred Material—Associated skeleton (KUVP 42740).

Description—Anteriorly diverging upper tooth rows, arch shaped fronto-premaxilla and fronto-nasal sutures.

Comments—KUVP 42740 is a juvenile, the dP4 is still present in the right maxilla and the left maxilla does not have a fully erupted P3 and P4.

UROCITELLUS SP. Obolensky, 1927

Referred Material—refer to Appendix 1.4. NISP = 179.

Description— P4 with a complete metaloph that is triangular in occlusal shape, upper molars with metaloph and more triangular occlusal shape than *Callospermophilus*, elongate M3 with metaloph, high trigonid on p4–m3, and elongate m3.

Comments—These specimens are certainly referable to the ground squirrel genus *Urocitellus* and the M3 specimens may be further placed in the "big-eared" species group (*U. beldingi*, *U. armatus*, *U. elegans*, *U. richardsonii*; Nadler et al., 1984). The M3 metaloph is more developed in the “big-eared” species group than in the "small-eared" species group (*U. brunneus*, *U. townsendii* complex; Nadler et al., 1984; Goodwin, 2004) and are smaller than members of the "long-eared" forms (*U. columbianus*, *U. parryii*; Nadler et al., 1984). Members of the “big-eared” species group overlap broadly odontometrically, but the Natural Trap Cave sample has a narrower p4 trigonid than most members. The Natural Trap Cave specimens are most similar in p4 dimensions to *U. elegans* (Fig. 4).

The Thirteen-lined Ground Squirrel (*Ictidomys tridecemlineatus*) is the only modern ground squirrel, exclusive of the Marmot, in the Big Horn Mountains (Long, 1965). The nearest modern member of the genus *Urocitellus* is the Wyoming Ground Squirrel (*U. elegans*) on the southern edge of the Big Horn Basin (~160 km south of Natural Trap Cave; Long, 1965). Richardson's Ground Squirrel (*U. richardsonii*) also is found to the north and west in Montana and Idaho (Hall, 1981).

UROCITELLUS RICHARDSONII or *ELEGANS*

Referred Material—refer to Appendix 1.4. NISP = 28.

Description—Prominent trench lingual to the ectolophid and hypoconid on the m3.

Comments—Both Richardson's Ground Squirrel (*Urocitellus richardsonii*) and the Wyoming Ground Squirrel (*U. elegans*) share a prominent trench on the m3 (Goodwin, 2004). Extant members of these species cannot be differentiated without the aid of the baculum, vocalizations, or a complete skull and dentaries (Neuner, 1975; Michener and Koeppl, 1985). *U. richardsonii* and *U. elegans* may have belonged to a single fossil taxon during the Pleistocene however. Neuner and Schultz (1979) described the baculum of a complete fossil skeleton that combined the traits of both *U. richardsonii* and *U. elegans* and suggested that the fossil baculum was the ancestral state for both taxa. These species also overlap odontometrically, although modern *U. elegans* and the Natural Trap Cave *Urocitellus* tend to be smaller than *U. richardsonii* (Fig. 5). The Natural Trap Cave *Urocitellus* are most similar to *U. elegans*, but may represent the extinct ancestor of both taxa, with similar size and a narrower trigonid than *S. elegans*.

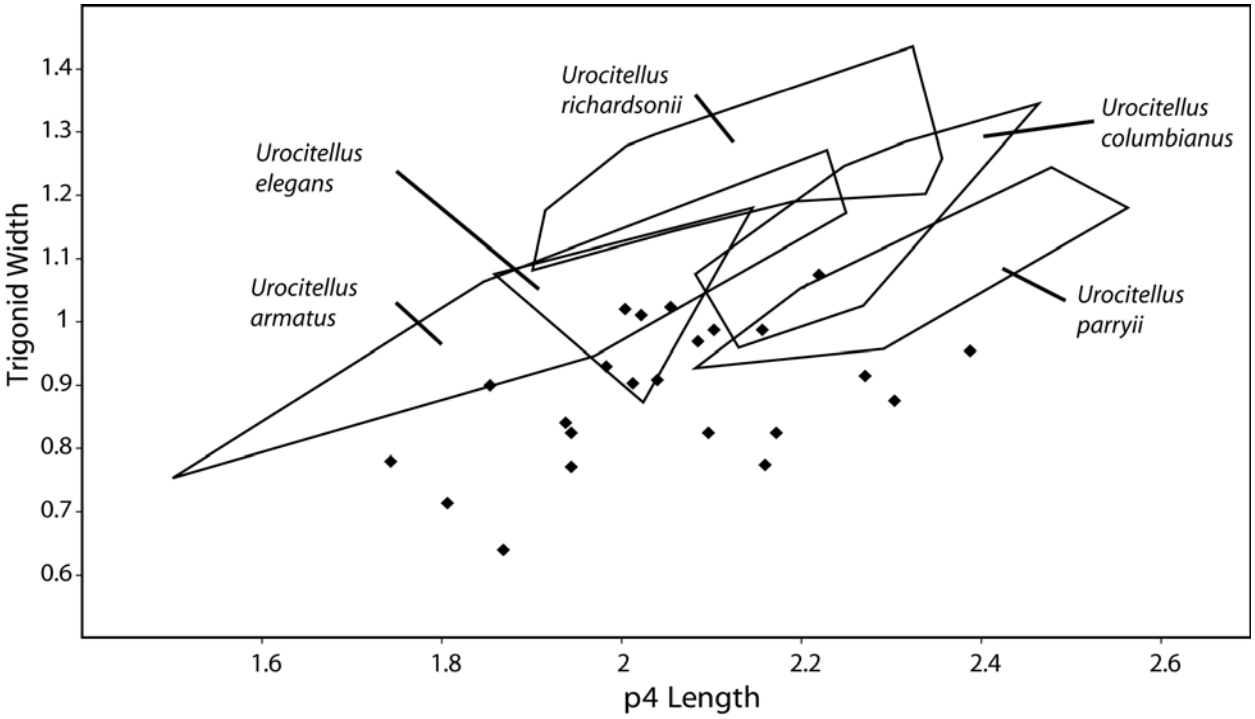


Figure 6. p4 analysis of Natural Trap Cave *Urocitellus* (diamond pattern). Ranges of variation for modern species are outlined.

CYNOMYS SP. Rafinesque, 1817

Referred Material—1 R P4 (KUVP 147972); 2 R M1 or M2 (KUVP 148895, 148896); 2 R M3 (KUVP 147069, 148892); 1 R dentary with m2 (KUVP 148894).

Description—Medium-sized ground squirrel, M3 with a short accessory loph on the posterior side of the labial end of the protoloph, P4–M2 are triangular in occlusal view, similar to *Urocitellus,* but generally wider than *Urocitellus*.

Comments—These specimens are certainly prairie dogs (*Cynomys*), but lack the characters for a subgeneric classification. They are all relatively small, however, and are therefore probably referable to the white-tailed prairie dogs (*Cynomys* (*Leucocrossuromys*)). Prairie dogs occur in every stratum within Natural Trap Cave except Unit 2 (18–15 ka).

CYNOMYS (*LEUCOCROSSUROMYS*) SP. Hollister, 1916

Referred Material—1 R P3 (KUVP 148893); 1 R, 1 L p4 (KUVP 148889, 148890); R dentary with m1—m3 (KUVP 148891), 1 L dentary with p4—m2 (KUVP 148897).

Description—*Cynomys*, notch bordering anterior cingulum of P3, wider trigonid on p4 than subgenus *Cynomys*, presence of a bridge between the talonid and ectolophid of m3, weak to no anterior deflection of the hypoconid on m3.

Comments—These specimens are referable to the subgenus *Cynomys* (*Leucocrossuromys*), but are too incomplete for a specific identification. These specimens are generally large for whitetails however, so they most likely represent the White-tailed Prairie Dog (*Cynomys leucurus*).

CYNOMYS LEUCURUS Merriam, 1890

Referred Material—Partial skull and dentaries (KUVP 123030).

Description— Stylid connecting the ectolophid and talonid on the m3, *C. leucurus* is larger than *C. gunnisoni* and *C. parvidens*, but smaller than the extinct *C. niobrarius*.

Comments—Goodwin (1990), in his description of *Cynomys niobrarius* as a separate whitetail species based on its large size and differences in shape of the palate and skull, identified KUVP 123030 as the extinct *C. niobrarius*. The skull in KUVP 123030 does not have the palate preserved, so my identification is based on the mandibular tooth row length, which Goodwin (1990) found to be significantly larger in *C. niobrarius* than any other white-tailed prairie dog. Both mandibular tooth rows on KUVP 123030 are much closer to the population mean for the White-tailed Prairie Dog (*C. leucurus*) than *C. niobrarius* (Table 1). KUVP 123030 is from Unit 3 (25–21 ka) of Natural Trap Cave. The nearest late Wisconsinan localities that include *C. leucurus* are Horned Owl Cave, WY and January Cave, AB (FAUNMAP, 1994).

Taxa	MDALV
Cynomys leucurus	13.94 (0.49)
Cynomys niobrarius	14.84 (0.37)
KUVP 123030 (right)	14.05

Table 2. Comparison of KUVP 123030 with *Cynomys leucurus* and *Cynomys niobrarius*. MDALV = Dentary alveolar length. *C. leucurus* and *C. niobrarius* data from Goodwin (1990). Units are in mm.

GEOMYIDAE Bonaparte, 1845

THOMOMYS SP. Wied-Neuwied, 1839

Referred Material—see Appendix 1.2. NISP = 24.

Description—Small geomyid, lower molars with transverse enamel plates on both anterior and posterior surfaces, smooth upper incisors, form of M3 similar to M2 and M1.

Comments—Referred specimens are most likely the Northern Pocket Gopher (*Thomomys talpoides*) because dentaries with the posterior portion preserved have a well-developed narrow flange projecting posteriorly and ventrally below the condyle. Other members of the genus have a weakly developed dentary flange (Thaeler, 1980).

THOMOMYS TALPOIDES Richardson, 1828

Referred Material—see Appendix 1.2. NISP = 145.

Description—Smooth upper incisors, elliptical M3, sphenoidal fissure always restricted to small foramina, posterior edge of incisive foramina level anterior to infraorbital foramen, anterior prism of P4 triangular, I1 alveolus does not extend between alveoli for P4 and M1, lower molars with anterior and posterior transverse enamel plates, narrow flange projecting posteriorly and ventrally below the mandibular condyle, concave enamel plate on the anterior-lingual face of the p4.

Comments—Thaeler (1980) summarized a complex of skull characters separating slim-rostrum *Thomomys*, of which the Northern Pocket Gopher (*T. talpoides*) is a member, from heavy-rostrum *Thomomys*. Of these characters, the most often preserved in the NTC specimens is the exclusion of the I1 alveolus from the area between the P4 and M1 alveoli. The position of the incisive foramina is preserved in every NTC skull specimen, and the posterior edge is always anterior to or level with the infraorbital foramen, another slim-rostrum *Thomomys* character. Each p4 recovered has the concave antero-lingual enamel plate, a characteristic of *T. talpoides*, described by Thaeler (1980). *T. talpoides* occurs in all stratigraphic units in Natural Trap Cave.

HETEROMYIDAE Allen & Chapman, 1893

PEROGNATHUS SP. Wied-Neuwied, 1839

Referred Material—see Appendix 1.1. NISP = 31.

Description—Very small heteromyid, lower molars have two rows of paired cusps, P4's have one anterior and two posterior cups that form a transverse loph with wear, single anterior alveolus for the p4.

Comments—Species identification within pocket mice (*Perognathus*) is difficult because there are no reliable qualitative characters and all species found in Wyoming today are similar quantitatively. The Natural Trap Cave *Perognathus* were compared with modern Olive-backed Pocket Mouse (*P. fasciatus*) from Wyoming, the species currently found in the Bighorn Basin. The fossil specimens' lower tooth row lengths, measured from the alveoli, overlap the lower range of *P. fasciatus* (Table 2). The size of the Natural Trap Cave *Perognathus* p4's were comparable to that found in *P. fasciatus* (Table 2). Therefore, while small, the Natural Trap Cave *Perognathus* are similar in size to *P. fasciatus*. Pocket mice occur in stratigraphic units 1, 2, 3, and 6 (13–0, 18–15, 25–21, >100 ka) within Natural Trap Cave.

Taxa	DOL	P4 W	P4 L
Natural Trap Cave sample	3.92 (.138)	1.34 (.015)	1.45 (.070)
Perognathus fasciatus	4.19 (.146)	1.34 (.103)	1.40 (.130)

Table 3. Comparison of Natural Trap Cave *Perognathus* sp. to modern *Perognathus fasciatus*. DOL = Dentary occlusal length; Mean (standard deviation). Units are in mm.

CRICETIDAE Rochebrune, 1883

PEROMYSCUS SP. Gloger, 1841

Referred Material—see Appendix 1.1. NISP = 309.

Description— Brachyodont molars with an alternating cusp pattern, reduced M3 and m3, low coronoid process, and larger size than *Reithrodontomys*.

Comments— The observed size range in small fossil cricetid mice from NTC is comparable to the North American Deer Mouse, *Peromyscus maniculatus*, found in the Bighorn Mountains and Bighorn Basin and larger than harvest mice (*Reithrodontomys*) (Table 3). All isolated I1's of the proper size range were smooth, further evidence for the exclusion of *Reithrodontomys*, which has a grooved upper incisor.

Taxa	DOL	DOM
Natural Trap Cave fossil sample	3.69 (.156)	3.84 (.240)
Peromyscus maniculatus	3.72 (.129)	3.79 (.144)
Reithrodontomys megalotis	3.17 (.107)	3.11 (.080)

Table 4. Mean and standard deviation for modern Wyoming *Peromyscus maniculatus* and *Reithrodontomys megalotis* dentaries and maxillas compared with Natural Trap Cave *Peromyscus* sp. DOL = Dentary occlusal length, DOM = Maxilla occlusal length; Mean (standard deviation). Units are in mm.

Species identification within *Peromyscus* in a fossil context is difficult. Guilday et al. (1977) differentiated the White-footed Mouse (*Peromyscus leucopus*) and Deer Mouse (*P. maniculatus*), the two most widespread species in North America, based on qualitative characters. *P. leucopus* has a higher incidence of accessory styles and lophs, a more bilaterally symmetrical anteroconid, and a deeper anterior anteroconid reentrant than *P. maniculatus* (Guilday et al., 1977). *P. maniculatus* and *P. leucopus* are both present in Wyoming today, although the latter only in the eastern Powder River Basin. All of the NTC m1's in the same wear stage as that analyzed by Guilday et al. (1977) have the *P. maniculatus* pattern. Other widespread western *Peromyscus* species (such as *P. boylii*) have not been studied qualitatively or quantitatively however, so I assign the NTC small mice as *Peromyscus* sp. with the exclusion of

P. leucopus. *Peromyscus* are present in Units 1, 2, 3, 4, and 6 (13–0, 18–15, 25–21, 29–25, >100 ka) within Natural Trap Cave.

NEOTOMA SP. Say & Ord, 1825

Referred material—see Appendix 1.1. NISP = 373.

Description—Rooted prismatic teeth with no cementum in the reentrant angles, two roots per tooth alveolus, large size relative to many cricetids, and gracile morphology of the dentary and maxilla relative to the similar-sized *Ondatra*.

Comments—These specimens are relatively similar in size to the Bushy-tailed Woodrat (*Neotoma cinerea*) and probably represent that taxon. Woodrats are present throughout Natural Trap Cave.

NEOTOMA CINEREA Ord, 1815

Referred material—see Appendix 1.1. NISP = 308.

Description—*Neotoma* molars with pits in all molar reentrants, frequently with stylids, and an elongate posterobuccal m1 reentrant.

Comments— Bushy-tailed Woodrats (*Neotoma cinerea*) commonly use rock outcrops as nests (Finley, 1958). Today, the rocky terrain surrounding Natural Trap Cave is dotted with their nests, and the cave itself has modern evidence of woodrat nests. *N. cinerea* was observed on the cave floor during excavation. *N. cinerea* is one of the most common taxa found in Natural Trap Cave and have evidently used Natural Trap Cave as a nesting site in the Holocene and Pleistocene.

Repenning (2004) discussed several dental characteristics found only in *Neotoma cinerea*: presence of pits in most reentrants frequently associated with stylids on posterior reentrants, prominent m1 and M1 anteromedial groove that extends to the enamel base, posterior

buccal reentrant wider in the anterior-posterior direction than the anterior buccal reentrant. All Natural Trap Cave teeth had reentrants with pits. Upper and lower first molars not severely worn had the deep anteriomedial groove characteristic of *Neotoma cinerea* and m1's not severely worn showed the wide posterior buccal reentrant. Stylids were most frequently found in the posterior buccal reentrant of the m2.

MICROTUS SP. Schrank, 1798

Referred material—see Appendix 1.1. NISP = 88.

Description—Molars are prismatic and rootless with cementum in reentrant angles; alveolus for the m1 has an anterior medial curvature for the m1 anterior complex not present in *Lemmiscus curtatus*.

Comments—An articulated palate (KUVP 84990) did not have the five-triangle morphotype in the M2, a character indicative of the Meadow Vole (*Microtus pennsylvanicus*), so there is no evidence for the presence of *M. pennsylvanicus* in the NTC sample. Size comparisons indicated these specimens are similar to modern Montane Voles (*M. montanus*) and Long-tailed Voles (*M. longicaudus*) in size. *Microtus* are present throughout Natural Trap Cave.

MICROTUS MONTANUS Peale, 1848

Referred material—see Appendix 1.1. NISP = 1.

Description—Molars are rootless, prismatic, cementum in their reentrant angles, m1 with five closed triangles. The median side of T7 is less open than in *Microtus longicaudus* and *M. pennsylvanicus*, but more open than *Microtus richardsoni* and *M. xanthognathus*.

Comments—Complete five-triangle m1's were identified to species using occlusal landmark data in a discriminant function analysis. The discriminant function had a high jackknifed identification success rate (87%). The group means for several variables, including

X8, were highly correlated with the discriminant function (>0.7). X8, a measure of the degree of closure of T7 (medial triangle immediately posterior to the anterior complex), provided the best separation of most five-triangle *Microtus* species. The Montane Vole (*Microtus montanus*) has a median group mean value for this variable, indicating a moderately closed T7 (Fig. 6 A). Within Natural Trap Cave the Montane Vole is from a stratigraphic unit where the contact between Units 1 and 2 was indistinct so the age of this specimen is inclusive of both units (18–0 ka).

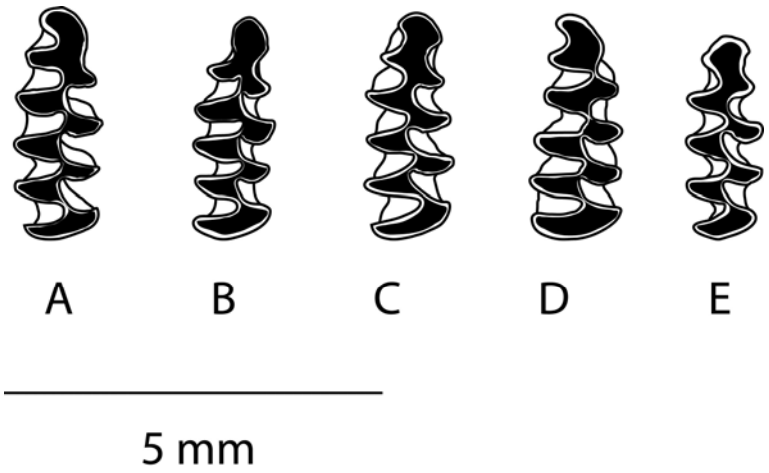


Figure 7. Arvicoline right m1s from Natural Trap Cave: (A) KUVP 148497 *Microtus montanus*, (B) KUVP 42530 *M. longicaudus*, (C) KUVP 64791 *Microtus ochrogaster*, (D) KUVP 64826 *M.* cf. *miurus*, (E) KUVP 148526 *Lemmiscus curtatus* four-triangle morphotype.

MICROTUS LONGICAUDUS Merriam, 1888

Referred material—see Appendix 1.1. NISP = 43.

Description—Molars are rootless, prismatic, cementum in their reentrant angles, m1 with five closed triangles. The median side of T7 is more open than in other *Microtus*

Comments—The Long-tailed Vole (*Microtus longicaudus*) had the lowest group mean for X8, meaning T7 is more open than any other five-triangle *Microtus* species (Fig. 6 B). *M.*

longicaudus is known from Units 1, 2, 3, 4, and 6 (13–0, 18–15, 25–21, 29–25 , and >100 ka) within Natural Trap Cave.

MICROTUS OCHROGASTER Wagner, 1842

Referred material—see Appendix 1.1. NISP = 5.

Description—m1 with a dentine connection between 6th and 7th reentrant angles.

Comments—The Prairie Vole (*Microtus ochrogaster*) has been found only in the Pleistocene levels, although suitable habitat, sagebrush (*Artemisia*) steppe, currently exists on Little Mountain and modern populations were reported by Long (1965) at nearby localities above and below Natural Trap Cave in elevation. *M. ochrogaster* is known from Natural Trap Cave Units 2, 3, and 5 (18–15, 25–21, and 100–29 ka).

MICROTUS cf. *MIURUS* Osgood, 1901

Referred material—see Appendix 1.1. NISP = 1.

Description—m1 with a shallow 8th reentrant angle and a confluent fifth and sixth triangle.

Comments—The shallow eighth reentrant angle and confluent fifth and sixth triangle seen in KUVP 64826 (Fig. 6 D) is a character often found in samples of modern Singing Voles (*Microtus miurus*), but has also been found in fossil samples of the Meadow Vole (*M. pennsylvanicus*). Guilday et al. (1964) described an m1 in a dentary that exhibited the shallow reentrant angle from a Pleistocene locality in Pennsylvania. The dentary was articulated with an *M. pennsylvanicus* skull however (Guilday et al., 1964). In modern samples of *M. pennsylvanicus* that I have not found an example of confluence of the fifth and sixth triangle, but this character can easily be found in modern *M. miurus* however.

The geographic distribution of *Microtus miurus* during the Pleistocene was far south of its modern range. *Microtus miurus* is currently found in Alaska and northern Canada, where it inhabits alpine tundra (Banfield, 1974; Hall, 1981). The only occurrences south of the Wisconsinan glaciers are from Conklin Quarry, IA and Elkader, IA (FAUNMAP, 1994). Within Natural Trap Cave, *M. miurus* is known from Unit 2 (18–15 ka).

LEMMISCUS CURTATUS Cope, 1868

Referred material—see Appendix 1.1. NISP = 81

Description—m1 with a simple anterior loop, one triangle confluent with the anterior loop, closed triangles small relative to the size of the tooth; anterior most lingual triangle particularly wide; reentrant angles two, four, and six are box-like; anterior margin of m1 alveolus conforms to the simple anterior loop; M3 with an anterior loop, two alternating triangles, and an anterioposteriorly elongated posterior loop.

Comments—The Sagebrush Vole (*Lemmiscus curtatus*) has two modern m1 morphotypes (five and six triangle types) that vary in frequency during the Pleistocene with an additional, now extinct, four-triangle morphotype. The Natural Trap Cave *L. curtatus* sample contains four, five, and six triangle morphotypes (Fig. 6 E). The five-triangle morphotype is common throughout the Natural Trap Cave sedimentary sequence, while the six-triangle type is found only in Unit 3 (25–21 ka), and the four-triangle morphotype is found in both Units 2 (18–15 ka) and 3.

DICROSTONYX SP. Gloger, 1841

Referred material—2 R, 1 L M1 (KUVP 148882, 148883, 148884); 1 L M2 (KUVP 148888); 2 R m1 (KUVP 43738, 43740).

Description—Microtine with nearly symmetrical teeth, no cementum in reentrant angles, m1 with more than six closed triangles.

Comments—Martin et al. (1979) reported on the presence of collared lemmings (*Dicrostonyx* sp.) from Natural Trap Cave based on two right m1's (KUVP 43738, 43740). Within NTC, *Dicrostonyx* is restricted to Unit 3 (25–21 ka). *Dicrostonyx* is known from several localities that were located south of the continental ice sheet during the Wisconsin glacial age in Iowa, Wisconsin, Nebraska, Wyoming, Idaho, Montana, and Alberta (FAUNMAP, 1994). Two of these localities, False Cougar Cave and Prospects Shelter are geographically close, <50 km, from Natural Trap Cave.

DICROSTONYX GROENLANDICUS Traill, 1823

Referred material—3 R, 1 L m3 (KUVP 148881, 148885, 148886, 148887).

Description—Presence of a well-developed anterior internal loop on m3.

Comments—Identifying a *Dicrostonyx* specimen to species requires the M1, M2, or m3. The Northern Collared Lemming (*Dicrostonyx groenlandicus*) has a more complicated enamel pattern than the Ungava Collared Lemming (*D. hudsonius*) on each tooth. Chomko and Gilbert (1987) referred to the *Dicrostonyx* in Natural Trap Cave as *D. torquatus*, but current usage suggests *D. groenlandicus* is more appropriate (Nowak, 1999).

Discussion

Last Interglacial fauna

The small mammal fauna from Unit 6 (>100 ka) has not been fully reported until now. Preliminary reports by Chorn et al. (1988) and Martin and Kadivar (2003) placed the number of small mammal taxa at nine: Pygmy rabbit (*Brachylagus idahoensis*), Black-tailed Jackrabbit (*Lepus californicus*), a cricetine rodent, three sciurid taxa, woodrat (*Neotoma*), an arvicoline rodent, and a soricid shrew. The Natural Trap Cave LIG is larger than previously reported largely due to the downward extension of the stratigraphic range of taxa found in Units 1–5 (Fig. 7). Several taxa that were present in strata younger than the LIG (e.g., *Myotis* sp., *Sylvilagus* sp., *Thomomys talpoides*, *Perognathus* sp.) were also found in Unit 6 (>100 ka). Chorn et al. (1988) and Martin and Kadivar (2003) listed *Lepus californicus* as present in the lower sequence, but no cranial elements from this large leporid were found in the lower sequence. The *Lepus* cranial elements found in the lower sequence are more similar in size to the smaller *L. townsendii* than the larger *L. californicus*.

The Natural Trap Cave LIG fauna contains shared elements with faunas to the east in the Great Plains, as well as to the west in the Great Basin. Overall, the fauna is most similar to other northern Great Plains faunas (Riddell, Medicine Hat # 7). An important shared taxon with the Great Basin faunas is the Pygmy Rabbit (*Brachylagus idahoensis*), which is shared with the American Falls and Silver Creek faunas (Table 4). The presence of *Brachylagus* in Natural Trap Cave is evidence for a significant dispersal event eastward from the Great Basin to the Bighorn Basin during the LIG. This is also evidence for a different climate in the area during the Last Interglacial vs. the current interglacial. The Pygmy Rabbit requires habitat with extensive

sagebrush (*Artemisia*) and greasewood (*Sarcobatus*) cover (Green and Flinders, 1980).

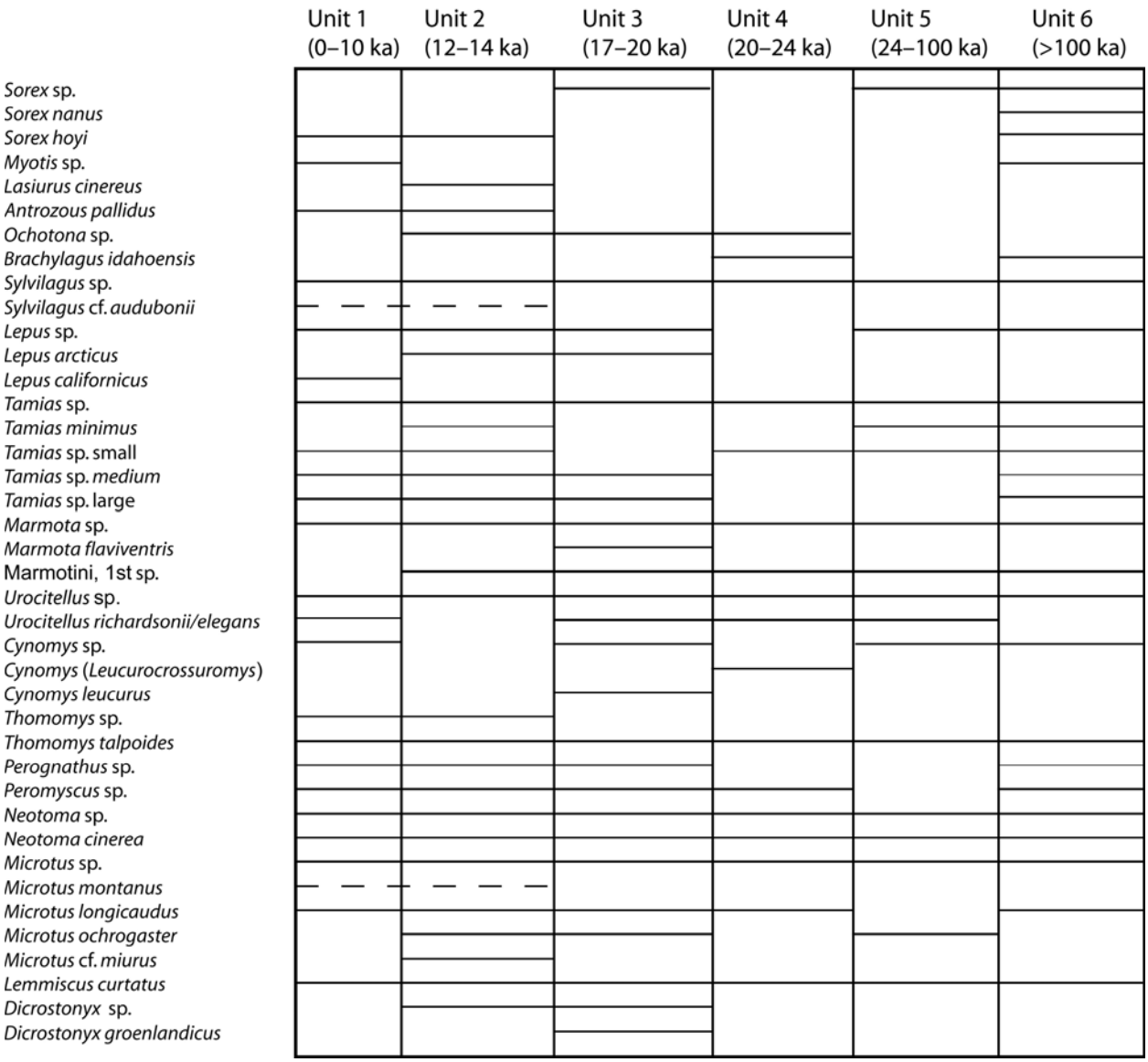


Figure 8. Natural Trap Cave faunal list showing the stratigraphic distribution of small mammals (<5kg). Stratigraphic units listed at the top are described in Figure 2.

Possible Pygmy Rabbit habitat in the Bighorn Basin is currently restricted to pockets in higher elevations on the basin's boundaries (Driese et al., 1997).

The Natural Trap Cave LIG fauna also contains many unique taxa however, most likely due to unique local ecology. Natural Trap Cave is located on a plateau in the foothills of the

Bighorn Mountains, 4 km from the nearest permanent water source, whereas the other faunas analyzed are from river terraces and lacustrine deposits. Natural Trap Cave preserved a dry upland mammalian fauna lacking some of the aquatic habitat associated taxa, such as beaver (*Castor*) and muskrat (*Ondatra*) that the Silver Creek, American Falls, and Medicine Hat #7 faunas possess (Table 4).

Paleoecology

The small mammal fauna in Natural Trap Cave records local habitat change over the course of the last glacial cycle. Natural Trap Cave is located on an elevational cline that separates the wetter Bighorn Mountains from the more arid Bighorn Basin and as a result is part of a transitional faunal zone between mountain and basin mammalian faunas (Long, 1965). Alpine glaciation during the Wisconsinan glacial age depressed biomes in the mountain ranges of Wyoming and during interglacial ages these biomes moved up elevation (Mears, 1981). The interglacial Natural Trap Cave units (Units 1, 5, and 6) generally include more taxa found in the arid basins today, while the glacial units (Units 2, 3, 4) contain more montane taxa. The arid basin taxa and those found in both areas tend to persist throughout the sequence though, indicating montane habitats (alpine tundra and coniferous forests) never fully displaced the habitat types conducive to the basin taxa.

During the interglacial stratigraphic units (Units 1 and 6) the Natural Trap Cave fauna generally contained more arid adapted taxa than during the units deposited primarily during the Wisconsinan glacial age. Unit 6 (>100 ka) contained the Pygmy Rabbit (*Brachylagus idahoensis*), a modern inhabitant of sagebrush (*Artemisia*) and greasewood (*Sarcobatus*) shrublands in Idaho (Green and Flinders, 1980). The presence of *Brachylagus* in Unit 6 (>100

ka) may also be evidence for less arid conditions in the Bighorn Basin during the LIG relative to the Holocene. The eastern edge of the Pygmy rabbit's range is in Idaho and Utah,

Taxa	NTC	AF	SC	MH7	RL	CN	JB	MM
Sorex sp.	X							
Sorex nanus	X							
Sorex hoyi	X							
Sorex palustris			X					
Sorex cinereus							X	
Blarina brevicauda							X	
Lasiurus cinereus						X		
Lasiurus golliheri						X		
Myotis sp.	X							
Brachylagus idahoensis	X	X	X					
Sylvilagus floridanus				X				X
Sylvilagus sp.		X		X		X		X
Lepus americanus					X			
Lepus townsendii			X	X				
Lepus sp.	X	X	X	X				
Tamias minimus	X		X					
Tamias sp.	X							
Marmotini sp. (ground-squirrels)	X	X					X	
Marmota sp.	X							
Urocitellus richardsonii				X	X			
Urocitellus cf. *armatus*			X					
Urocitellus parryii					X			
Urocitellus sp.	X							
Ictidomys tridecemlineatus						X		X
Cynomys leucurus				X				
Cynomys niobrarius		X						
Cynomys ludovicianus					X			X
Cynomys gunnisoni								X
Cynomys sp.	X							
Thomomys talpoides	X		X	X	X			
Thomomys townsendii		X						
Geomys bursarius						X		X
Geomys sp.						X	X	

Taxa	NTC	AF	SC	MH7	RL	CN	JB	MM
Dipodomys ordii						X	X	
Chaetodipus hispidus						X	X	X
Perognathus sp.	X						X	
Peromyscus progressus						X		
Peromyscus cochrani						X	X	
Peromyscus craigini								X
Peromyscus maniculatus			X	X				
Peromyscus sp.	X				X		X	
Onychomys leucogaster						X	X	
Onychomys jinglebobensis							X	
Reithrodontomys megalotis						X		
Reithrodontomys montanus							X	
Oryzomys palustris							X	
Neotoma cinerea	X							
Neotoma micropus						X		
Neotoma sp.	X					X	X	X
Phenacomys intermedius			X		X			
Myodes gapperi					X			
Microtus ochrogaster						X	X	X
Microtus longicaudus	X							
Microtus pennsylvanicus					X			
Microtus sp.	X		X	X	X			
Lemmiscus curtatus	X				X			
Synaptomys australis							X	
Zapus hudsonicus							X	
Castor canadensis		X			X	X		
Ondatra zibethicus		X		X	X			
Ondatra sp.			X					
Erethizon dorsatum		X	X	X				

Table 5. Comparison of the Natural Trap Cave LIG fauna with the closest contemporaneous faunas: American Falls, ID (data from Pinsof, 1992); Silver Creek, UT (data from Miller, 1976); Medicine Hat #7, AB (data from Pinsof, 1996); Riddell, SK (data from Pinsof, 1996); Cragin Quarry, KS (data from Pinsof, 1996); Jinglebob, KS (data from Pinsof, 1996); Mesa de Maya, CO (data from Hager, 1974).

although an isolated population has been reported in southwestern Wyoming (Green and Flinders, 1980; Campbell et al., 1982). Major mountain ranges and unfavorable habitat in the lowlands between mountain ranges largely isolates possible *Brachylagus* habitat in the Bighorn Basin from western areas where the Pygmy Rabbit occurs today. Therefore, the sagebrush steppes must have been more extensive and interconnected during the LIG to allow for the dispersal of *Brachylagus* into the Bighorn Basin. More extensive sagebrush cover would be indicative of less arid climate and extreme temperatures than the current conditions in the Bighorn Basin. Other arid basin taxa found in Natural Trap Cave in Unit 6 (>100 ka) include pocket mice (*Perognathus* sp.), and Sagebrush Vole (*Lemmiscus curtatus*). Sagebrush Voles are present throughout the Natural Trap Cave sedimentary sequence however, an indication that their preferred habitat of sagebrush (*Artemisia*) and bunchgrasses may have been reduced during the glacial periods but never entirely eradicated from the area (Carroll and Genoways, 1980).

The faunal interpretation for a more equable climate during the LIG at Natural Trap Cave is corroborated by paleobotanical evidence. Gilbert et al. (1980) interpreted an abundance of Festucoid (C_3 grasses) opal phytoliths (90 % relative abundance) in the lower sequence of Natural Trap Cave as evidence for a cooler growing season and wetter climate than currently exists near Natural Trap Cave. A preliminary pollen study found only that Unit 6 (>100 ka) was warmer than the glacial levels, with higher levels of greasewood (*Sarcobatus*) and possibly saltbush (*Atriplex*) than Units 2 and 3 (Johnson and Fredlund, 1982).

Unit 1 (13–0 ka) has arid-adapted taxa not found in Unit 6 (>100 ka). The presence of Black-tailed Jackrabbit (*Lepus californicus*) and Pallid Bat (*Antrozous pallidus*) in Unit 1 may be evidence for more arid conditions at Natural Trap Cave than what occurs there today. Black-tailed Jackrabbit is not an exclusive indicator of arid environments, although it does only

frequent open habitats. In Mexico it is almost exclusively a desert dweller, while in Arizona it is found in a variety of grasslands (Best, 1996). The modern distribution of *L. californicus* includes southeastern Wyoming (Long, 1965). Pallid Bat (*Antrozous pallidus*) is another common taxon in the deserts and arid grasslands of the southwest from Mexico to Canada, but not in Wyoming (Hermanson and O'Shea, 1983). The distribution of the Pallid Bat extends into Wyoming in the southwestern and southeastern corners of the state (Durrant and Dean, 1960; Stromberg, 1982). The elevational filter of the surrounding mountains also probably hinders the extension of the Pallid Bat and Black-tailed Jackrabbit's ranges into the Bighorn Basin, like the Pygmy Rabbit. Dispersal of southern taxa into the salt-desert shrubland of the Bighorn Basin would have required more arid conditions than currently exist to increase the elevational range of their habitats into the passes south of the Bighorn Basin.

The Holocene pollen and phytolith record in Natural Trap Cave does not have the resolution to isolated climate events, but other Bighorn basin climate records indicate an early Holocene trend towards warm and dry conditions. Lyford et al. (2002) inferred a warmer and more arid climate in the northern Bighorn Basin from 11–9 ka using Pryor Mountain packrat midden plant macrofossils. Fall et al. (1995) described rapid warming after 13,579 cal yr BP in the Wind River Mountains. The presence of *A. pallidus* in Unit 2 (18–15 ka) is also evidence for a possible early warm period predating the early Holocene.

Faunal indications of tundra appear in Natural Trap Cave in Unit 4 (29–25 ka) and persist through Unit 2 (18–15 ka). Pygmy Rabbit are also present in Unit 4, an indication that at least a portion of this unit was deposited before the onset of alpine glaciation in the Bighorn Mountains. The onset of the Pinedale glaciers at 23 ka evidently extirpated the Pygmy Rabbit from the region (Phillips et al., 1997). Two tundra specialist taxa are present in Units 2 and 3: Arctic

Hare (*Lepus arcticus*) and Collared Lemming (*Dicrostonyx groenlandicus*), both of which are restricted to the modern arctic tundra (Banfield, 1974). The presence of these artic tundra taxa is a strong argument for the development of this habitat near Natural Trap Cave.

There has been controversy regarding the fidelity of modern tundra mammals to that habitat in the past. Martin et al. (1979) argued that the lack of other characteristic tundra animals like Caribou (*Rangifer tarandus*) and Muskox (*Ovibos moschatus*) in Natural Trap Cave indicated that despite the presence of *Dicrostonyx,* true tundra was not present at Natural Trap Cave. Mead and Mead (1989) also noted that *Dicrostonyx* commonly occurs in fossil contexts with other non-tundra taxa and favored using the taxon as an indicator of a boreal environment with tundra affinities instead of a strict tundra indicator. There is evidence for alpine tundra near to Natural Trap Cave that *Dicrostonyx* may have been associated with. Two alpine tundra taxa are present in Natural Trap Cave: Pika (*Ochotona*) are present in Units 2, 3, and 4 (29–15 ka) and Singing Vole (*Microtus* cf. *miurus*) is present in Unit 2 (18–15 ka). The Pika and Singing Vole inhabit the alpine tundra today, *M. miurus* in Canada and Alaska while *Ochotona* occurs in that environment at higher elevations in the Bighorn Mountains today (Long, 1965; Banfield, 1974; Smith and Weston, 1990). The advance of the Pinedale (23–16 ka) glaciers in the Bighorn Mountains pushed habitat types down slope to a certain degree (Phillips et al., 1997). While Natural Trap Cave is located ~80 km NW of the nearest glacial deposits (Fig. 8), the topography of the Bighorn Mountains is such that there is little elevation change from the terminal moraine of the closest glacier and Medicine Mountain (~30 km from Natural Trap Cave). Medicine Mountain (3100 m) also has a modern population of pika isolated from other populations located at higher elevations in the formerly glaciated regions (Long, 1965). Therefore, much of the area between Medicine Mountain and the Bighorn glaciers must have been alpine tundra. Permafrost

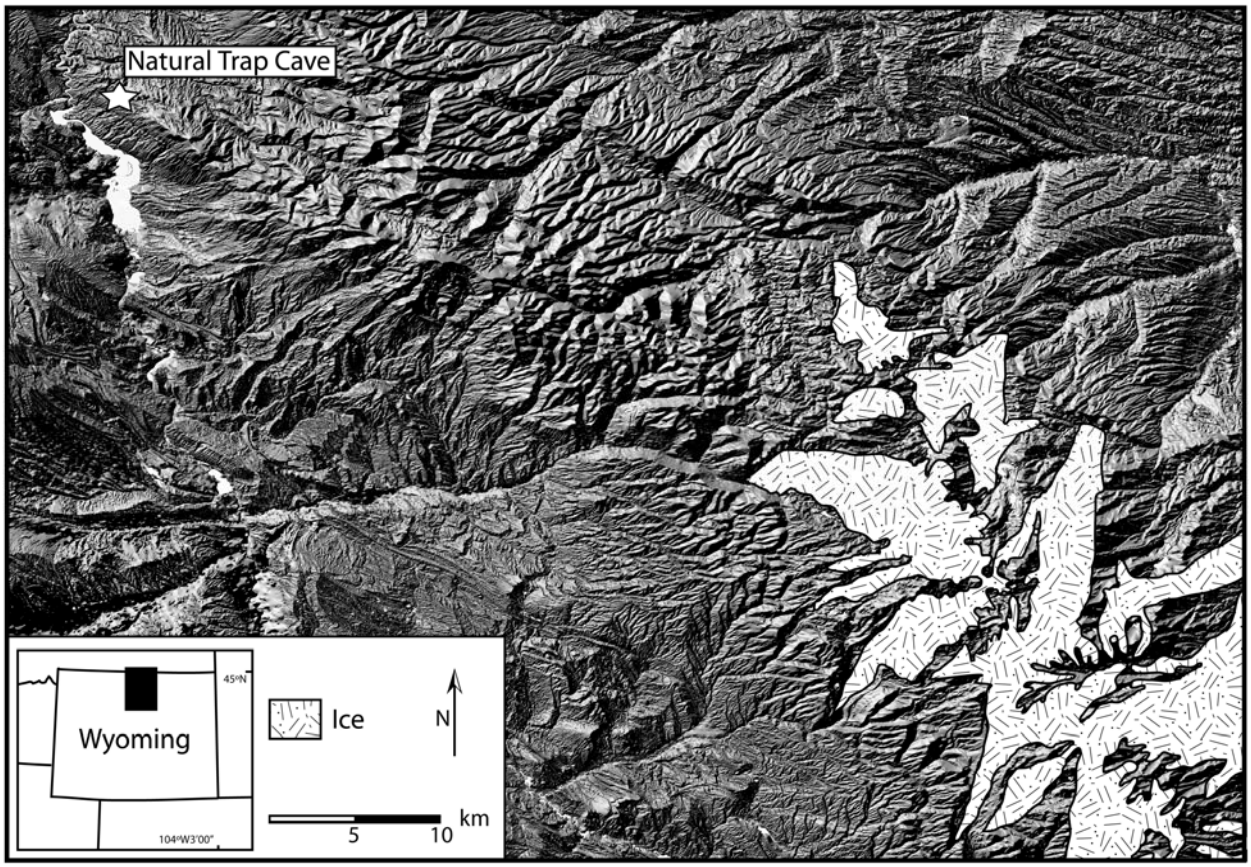


Figure 9. Topography of the northern Bighorn Mountains between Natural Trap Cave and furthest extent of the Pinedale Bighorn glaciers.

features suggestive of tundra are present in the Bighorn Basin floor, so the presence of tundra at altitude seems likely (Mears, 1981). The rarity of tundra-associated mammals in the fauna (NISP = 23) agrees with a hypothesis of transport from the Medicine Mountain area by an avian predator to the cave. Prairie Falcons (*Falco mexicanus*) have large hunting ranges, hunt in modern alpine tundra, and are present as fossils in Natural Trap Cave, so possible predators for these alpine taxa during the Pleistocene existed nearby (Marti and Braun, 1974; Peery, 2000).

Taxa that are found in non-tundra habitats also found in the glacial Natural Trap Cave units, which is more evidence for an avian predator that roosted near the cave and hunted at various elevations. The presence of Prairie Vole (*Microtus ochrogaster*) in Units 2 and 3 (18–15

and 25–21 ka) corroborates the evidence for non-tundra habitats near to Natural Trap Cave during the last glacial period. *M. ochrogaster* is found in sagebrush-grass communities in Wyoming today as well as other types of grassland habitat in other sections of its range (Maxwell and Brown, 1968; Stalling, 1990). Prairie Voles are present today in the Bighorn basin in areas near water, and have even been trapped in grass shrubland and riparian woods immediately west of the Bighorn River W and NW of Natural Trap Cave, although not on Little Mountain (Long, 1965; Chomko and Gilbert, 1987; Keinath, 2005). It seems unlikely that the lack of *M. ochrogaster* in Natural Trap Cave Unit 1 (13–0 ka) is the result of the loss of the Prairie Vole's predators because a wide variety of predators eat them (Stalling, 1990). The loss of *M. ochrogaster* could be the result of insufficient sampling or an indication that the Holocene conditions changed in the habitat near Natural Trap Cave where they were hunted.

The stratigraphic range of tundra mammals in Natural Trap Cave is similar to the known chronology of mountain glaciation in Wyoming. Phillips et al. (1997) described the age range of Pinedale glaciation in the Wind River Range to 23–16 ka using cosmogenic dating of boulders. This time period overlaps the deposition of Natural Trap Cave Unit 2 and Unit 3, which contain *Dicrostonyx* and *Ochotona* (Fig. 7), two obligate tundra inhabitants. Gosse et al. (1995) cosmogenically dated a later advance of the Wind River glaciers contemporaneous with the North Atlantic Younger Dryas Event (12.8–11.5 ka). A post-Pinedale glacial advance has also been recognized in the Bighorn Mountains (Nelson, 1977). The presence of *Antrozous pallidus* and *Lepus californicus* in Unit 1 are indicators of a non-uniform Holocene climate at Natural Trap Cave, but there is no evidence of a "cold-snap" severe enough to lead to reintroduction of tundra taxa in the vicinity of the cave.

The paleobotanical record from the Natural Trap Cave area does indicate an environment with similarities to the modern tundra during the deposition of Units 2, 3, and 4 (18–15, 25–21, and 29–25 ka). The pollen record from the glacial age sediments contains a diverse non-arboreal pollen assemblage similar to that seen in modern tundra (Johnson and Fredlund, 1982). Other paleobotanical evidence from the area suggests that there were patches of coniferous forests also. Wells (1983) examined woodrat nests in the canyon near the cave entrance and found that Limber Pine (*Pinus flexilis*) was the dominant species with associated Spruce (*Picea engelmannii*) >27 ka. Woodrats usually collect plants from within a 30 m radius of their nests, so the Limber Pine and Spruce were at least present in the valley adjacent to Natural Trap Cave (Finley, 1990). These species are found 600–900 m higher in elevation E and SE of Natural Trap Cave today (Wells, 1983). Therefore it seems that the coniferous forest belt was already near Natural Trap Cave immediately before the deposition of the Pinedale glacial deposits, and the Pinedale advance caused the expansion of tundra down to the Little Mountain area.

Lemmiscus curtatus

Natural Trap Cave is one of the chronologically latest localities to include the extinct four-triangle morphotype of Sagebrush Vole (*Lemmiscus curtatus*). During the Pleistocene, the Sagebrush Vole had three distinct m1 morphologies: four, five, and six-triangle morphotypes (Barnosky and Bell, 2003). The last record of four-triangle morphotype *L. curtatus* is in Snake Creek Burial Cave, Nevada, which is bracketed by a Holocene radiocarbon date (10,720 ± 167 cal yr BP) and a Pleistocene uranium series date (15,100 ± 700 ka) (Bell and Mead, 1998). All other occurrences of the four-triangle morphotype (SAM Cave, NM; Cathedral Cave, UT; Kennewick Roadcut, WA) are either early Rancholabrean or Irvingtonian in age (Repenning, 1992; Bell, 1995; Rensberger et al., 1984; Rensberger and Barnosky, 1993).

The four-triangle morphotype is present in small numbers (4%) in Natural Trap Cave Units 2 and 3, but not in Unit 1, so this morphotype was restricted to the Pleistocene in northern Wyoming also. The four-triangle morphotype evidently persisted in widely disjunct sections of *Lemmiscus curtatus*' range until the end of the Pleistocene, at which point the five and six-triangle morphotypes became the only observed occlusal pattern. Further study of the geographic appearance of the three morphotypes may reveal a mosaic evolutionary pattern similar to that seen in dental evolution of Pleistocene Meadow Voles (*Microtus pennsylvanicus*) (Barnosky, 1993).

Conclusions

Natural Trap Cave preserves a diverse small mammal fauna that reflects climate change over the course of the last glacial cycle. Natural Trap Cave is also a unique (geographically, ecologically, and taphonomically) small mammal record for the LIG. No other locality in the region preserved a diverse upland small mammal fauna. The LIG climate was similar to today but less arid. The following climate shift during the Wisconsinan glacial age was to cooler and wetter conditions, with faunal indicators of habitats nearby similar to tundra and sage-grasslands. The Holocene era was warm and arid relative to the preceding glacial period; the presence of the Black-tailed Jackrabbit (*Lepus californicus*) and Pallid Bat (*Antrozous pallidus*) in the Holocene strata of Natural Trap Cave is evidence for a non-uniform Holocene climate. Natural Trap Cave may also be useful in future study of population-level evolution in small mammals because it is one of the last occurrences of the extinct four-triangle morphotype of *Lemmiscus curtatus*.

CHAPTER 3

Small mammal taphonomy of Natural Trap Cave

The primary taphonomic objective for Natural Trap Cave is to determine if accidental death or introduction by a predator, whether directly or through woodrat (*Neotoma*) collecting, was the dominant means of forming the assemblages. If accidental death were the most important taphonomic pathway, then bias of predator selection would be removed from the paleocommunity. If the cave served as a roost for avian predators, this causes a bias towards whatever prey the predators preferred. Woodrats accumulate a variety of scats, pellets, and individual bones, so collection by these rodents would be less biased than a pellet assemblage from avian predators roosting in the cave. A change in taphonomy between different strata of the cave also would have ramifications for interpreting observed faunal dynamics. The goal of this study is to document and interpret the small mammal taphonomy.

Predators of small mammals include snakes, mammalian carnivores, owls, falcons, hawks, eagles, and corvids. Each of these predators inflicts a different degree of damage to small mammal remains, leaving a signature in the pellets and carcasses that accumulate as a result of their feeding.

Snakes swallow their prey whole and typically digest all bone and teeth, so that most remaining material in the feces is hair and claws (Netting, 1932). Fitch and Twining (1946) observed that even when rodent teeth are found in feces they crumble easily due to acid digestion. Klauber (1997) observed that the most common teeth present in rattlesnake feces are the fangs of the snake, because the exterior and the internal venom ducts are sheathed in protective enamel. Therefore snake feces most likely do not contribute heavily to small mammal fossil assemblages.

Avian predators generally provide the best preservation of food remains among predators of small mammals. Most owls, like snakes, swallow their prey whole, inflicting minimal damage, and later regurgitate a pellet of largely undigested bone, hair, and chitin (Mayhew, 1977; Dodson and Wexlar, 1979; Hoffmann, 1988; Andrews, 1990). Pellets from small owls, such as the Screech Owl (*Megascops asio*) and Little Owl (*Athene noctua*), have a higher degree of bone fragmentation than larger owls because they partially dismember larger carcasses before swallowing (Hoffmann, 1988; Andrews, 1990). Falconiform raptors tear apart their prey before eating it and inflict more bone damage through digestion than owls (Mayhew, 1997; Hockett, 1989b; Andrews, 1990). Raptors leave behind much of the bone, skin, and indigestible organs at the kill site, roosts, and nests as a result (Andrews, 1990). Corvids also have been studied as predators of small mammals. In a Eurasian study of crow (*Corvus corone*), jackdaw (*Corvus monedula*), and magpie (*Pica pica*) pellets, Andrews (1990) only found one instance, in a magpie pellet, of small mammal remains. The vole skull found in the magpie pellet was not extensively damaged, leading Andrews (1990) to conclude that while corvids inflict minimal damage on bone, they are most likely not significant accumulators of bone. Laudet and Silva (2005) observed an eastern European population of Common Raven (*Corvus corax*) that accumulated significant amounts of bone in regurgitated pellets and also inflicted moderate damage on bone, on a level between most owls and diurnal raptors.

Mammalian carnivores chew their prey and damage bone more heavily in digestion than birds, therefore they leave behind more fragmented bone in their scat than other predators (Andrews and Evans, 1983; Andrews, 1990).

Thus, there is a wide degree of bone damage in predator scat and pellet assemblages: owls inflict the least amount of damage, falconiform raptors and corvids inflict moderate damage, while the most severe bone damage is caused by mammalian carnivores.

In most taphonomic studies, lagomorph taphonomy is treated differently from small rodents because their large size necessitates dismemberment before being eaten. Andrews and Evans (1983) and Andrews (1990) noted that when lagomorph limb bones are incorporated into feces, they are highly fragmented. In lagomorph postcranial bones usually only the bone immediately surrounding the articular surface is present (Andrews, 1990). Most predators of lagomorphs leave behind much bone unconsumed, so documentation of skeletal element proportions and fragmentation has been the main route of investigation. Hockett (1989b, 1991, 1995), Schmitt and Juell (1994), and Schmitt (1995) have carried out studies of modern pellet, scat, and carcass assemblages formed by avian and mammalian predators common to the western United States.

Studies of different predator-generated lagomorph assemblages have found different taphonomic patterns. Hockett (1991) found several common characteristics in lagomorph remains from mixed owl and falconiform pellet assemblages. The assemblages were predominantly *Sylvilagus* sp. (97% of mandibles)—bones exhibited puncture marks, shearing damage to the greater trochanter of the femora, a high proportion of juveniles, and a higher frequency of forelimb vs. hindlimb bones. Hockett (1989b, 1991, 1995) noted that implied raptor damage, observed as punctures on <1.5% of total bones, was most commonly seen on the innominate immediately posterior to the acetabulum. Schmitt (1995) collected lagomorph bones at Cathedral Roost, Utah, a Golden Eagle (*Aquila chrysaetos*) nest, and compared the resulting data with avian pellet and coyote (*Canis latrans*) scat assemblages (Schmitt and Juell, 1994).

Schmitt (1995) noted that the dominant prey taxon at the eagle nest was hares (*Lepus*) and the dominant skeletal elements were tibias and femora (Table 5). The coyote scats sampled had a more even distribution of leporid elements and a higher fragmentation rate than the eagle nest assemblage (92.9 vs. 83.6%). Mandibles, femora, and innominates were the most common elements (Table 5), most likely due to sections of these bones being the densest in the leporid skeleton (Pavao and Stahl, 1999).

Element	Coyote (*Canis latrans*) scat		Cathedral Roost (UT) Golden Eagle (*Aquila chrysaetos*) nest	
	NISP	%NISP	NISP	%NISP
Innominate	26	16.05	43	16.23
Dentary	52	32.10	16	6.038
Humerus	19	11.73	24	9.057
Ulna	15	9.259	11	4.151
Femur	34	20.99	65	24.53
Tibia	16	9.877	106	40
Total	162		265	

Table 6. Leporid prey remains collected from modern coyote scat and a Golden Eagle nest. Data taken from Schmitt and Juell (1994) and Schmitt (1995).

Past works on Natural Trap Cave postulated several taphonomic pathways for the small mammal taxa. Martin and Gilbert (1978) and Chomko and Gilbert (1987) noted the relative scarcity of small mammals (<5 kg) versus large mammals in the cave fauna as an important question to be answered. Martin and Gilbert (1978) noted the abundance of Common Ravens (*Corvus corax*) in the Holocene levels and theorized that ravens may have introduced much of the vertebrate microfauna by nesting in the cave. Chomko and Gilbert (1987) sought to explain the low number of small mammal elements relative to large mammals by hypothesizing that the small mammals originated from gut contents of mammalian predators that fell into the cave. Wang and Martin (1993) did not rule out roosting owls as a possible means of introducing the small mammal remains to Natural Trap Cave.

Natural Trap Cave had four likely taphonomic pathways for small mammals to be preserved in the cave: accidental death by falling; carcasses being washed in from the surface; introduction by a predator, as stomach contents in a falling carnivore or by avian roosting; and introduction by woodrats as part of a midden. No evidence exists of any other past entrance; the roof entrance is the only means of entering the cave, so carcasses from animals that accidentally fell in or were washed in could not be scavenged or trampled, unless avian predators flew in to scavenge them (Rushin, 1973). Topography of the Limestone outcrop surrounding the cave entrance does not allow for the washing of carcasses into NTC. There is widespread evidence of *Neotoma* nesting activity in the cave. Woodrats presumably enter through lateral fissures in the Madison Limestone that forms the walls of the cave (Rushin, 1973).

The objective of this analysis is to investigate the processes that led to deposition of small mammal herbivores (<5 kg) in Natural Trap Cave. First, determine if the small mammals are different taphonomically from the large mammals. Then, the importance of avian and mammalian predators as accumulators of the shrews, rodents, and lagomorph taxa is addressed. The relative influence of avian and mammalian predators on the collecting radius of the cave is then discussed. Finally, I address the consequences of the use of Natural Trap Cave for woodrat nests on faunal interpretations. Results show that the small mammals were underrepresented in the cave fauna during the Wisconsinan glacial section of Natural Trap Cave's stratigraphic record. Most rodent and lagomorph taxa show evidence of avian predation, although mammalian predators possibly collected some taxa. Woodrat scavenging of bone from surface carcasses and feces and incorporation into middens in Natural Trap Cave probably was the primary transporter of small mammal bones into the cave. Avian predator roosts were the primary source of the bone scavenged by the woodrats. Therefore, the collecting radius of

Natural Trap Cave is considerably larger than if the cave had acted primarily as a pitfall trap for small mammals.

Materials and Methods

The Natural Trap Cave locality is located in Bighorn County, WY approximately 25 km NE of Lovell, WY. The University of Missouri and the University of Kansas from 1973–1985 excavated the locality jointly. KUVP (University of Kansas Vertebrate Paleontology) received all faunal materials from the locality; so it is designated with the KU locality number KU-WY-090.

Excavation methods

Natural Trap Cave was excavated using stratified random squares. The cave floor was divided into a series of 2.3 m^2 quadrats, several of which were chosen at random for excavation. Initial excavation was done in 15.24 cm arbitrary levels, while subsequent excavations followed the natural stratigraphy. Large mammal bones were mapped at each excavation level before removal. A subsection of each level (30.48 cm X 30.48 cm X 15.24 cm) was saved for waterscreening (see Martin and Gilbert, 1978 for more on excavation methods). The small mammals in this study were collected primarily from the water-screened samples.

Taphonomic comparisons

To complete the size/abundance regression, NISP (Number of Individual Specimens), defined here as a simple count, is calculated for each herbivorous taxon represented in the cave based on maxillas, dentaries, and individual teeth identifiable to genus. NISP for the large mammal taxa is derived from catalogue data. Rare species are pooled into genera to establish a large sample size for each taxon ($n>5$). Natural Trap Cave stratigraphic Units 4 and 5 were combined because of the relatively low sample size for Unit 5 ($n = 69$). The log of each taxon's abundance is then regressed on the logarithm of its nearest modern relative's mean weight taken

from Nowak (1999) (Table 6). I perform the size/abundance regression for each stratigraphic unit (1–5) in Natural Trap Cave.

Taxon	Mass (g)	log W	A:raw	log A
Sorex sp.	4.5	.6532	22	1.342
Perognathus sp.	17.5	1.243	23	1.362
Peromyscus sp.	20	1.301	299	2.476
Lemmiscus curtatus	27.5	1.439	83	1.919
Tamias (*Neotamias*) sp.	41.7	1.620	227	2.356
Microtus sp.	49	1.690	53	1.724
Dicrostonyx sp.	71	1.851	8	0.903
Thomomys sp.	110	2.041	145	2.161
Ochotona sp.	146.5	2.166	14	1.146
Neotoma sp.	324.5	2.511	667	2.824
Brachylagus idahoensis	436.5	2.640	2	0.301
Urocitellus sp.	542.5	2.734	236	2.373
Cynomys sp.	877.5	2.943	12	1.079
Sylvilagus sp.	939	2.973	428	2.631
Marmota sp.	2800	3.447	80	1.903
Lepus sp.	3400	3.531	80	1.903
Antilocapra sp.	53000	4.724	46	1.663
Ovis canadensis	108000	5.033	368	2.566
Equus sp.	250000	5.398	1183	3.073
Bootherium sp.	305000	5.484	54	1.732
Bison sp.	675000	5.829	45	1.653
Camelops sp.	940000	5.973	10	1
Mammuthus sp.	2860000	6.456	7	0.845

Table 7. Late Pleistocene–Holocene Natural Trap Cave mammal assemblage. log W = logarithm of median mass; A:raw = NISP; log A = logarithm of NISP.

Examination of bones for wear, fragmentation, and rodent gnawing is done using an Olympus binocular dissecting microscope at 30x magnification. All data analysis is carried out in Microsoft Excel 2000 and Minitab 15. Only cranial and postcranial elements that could be correlated with radiocarbon dated bone or the dated volcanic ash form were used. Rodent, lagomorph, and soricid jaws are classified for bone weathering and separated into the categories established by Behrensmeyer (1978).

Due to a lack of modern comparative data for soricids and lagomorphs, only rodent jaws are classified for fragmentation using the criteria established by Andrews (1990). The categories were defined by the condition of the ascending ramus and condition of the medial side of the mandible (Fig. 9) and the absence of the incisor was noted also for each specimen.

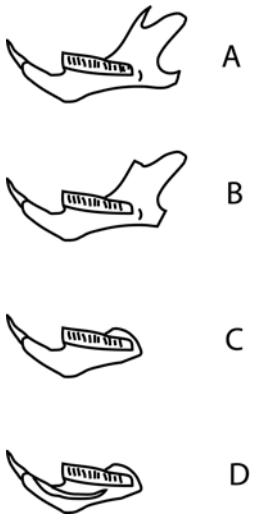


Figure 10. Mandible fragmentation classification. A = whole, B = ascending ramus damages, C = Ascending ramus missing, D = Ascending ramus missing and interior border of mandible damaged. Redrawn from Andrews (1990).

NISP is calculated for lagomorph dentaries, humeri, ulnas, innominates, femora, and tibias to compare with Hockett's (1991) and Schmitt's (1995) modern data for owl, Golden Eagle, and coyote accumulated assemblages. Limb bones are classified as proximal (with or without shaft), distal (with or without shaft), shaft only, and complete elements.

Results

Linear regression of taxon abundance on mean weight for the pooled data (all units combined) did not conform to the –1.05 slope of Damuth's (1982) idealized modern assemblage (Table 6; Fig. 10A). Large mammals (>5 kg) were over represented relative to small mammals and caused the slope of the regression for the pooled data to be near zero r = -.064 (p>.05). Units 3, and 4 contributed strongly to this trend, with a positive relationship between size and abundance within these units. This is caused largely by an increase in the diversity and abundance of large mammals in Units 3 and 4 relative to Units 1, 2, 5, and 6, especially in *Equus* and *Ovis.* Units 1, 5, and 6 most closely approached the negative relationship shown by Damuth (1982), although large mammals are still over represented (Fig. 10B, E, F). Thus, large and mid-sized mammals are most disproportionately represented at Natural Trap Cave during Units 3 and 4. Within Units 1, 5, and 6 the small mammals are still under represented, but to a lesser degree.

The majority of small mammal mandibles are in bone weathering stage one (57.1% total), with only surface cracks visible, followed in abundance by stages zero and three. Wear classes zero and one accounted for at least 80% of all specimens in each stratigraphic unit. There is no change in rank abundance of bone wear classes between age correlated strata, but in Unit 6 there is an increase in abundance of stage one and a decrease in all other classes (Fig. 11 B).

Mandible fragmentation was similar for all aged strata. Fragmentation classes A&B (minimal ascending ramus damage) are the most common in all strata, but class D (ascending ramus missing, interior border damaged) is nearly as great in proportion in Units 3, 4, 5, and 6 (Fig. 11A). Several taxa have a higher proportion of jaws in the more damaged classes (C and

D) than the average, while the proportion in some taxa changes between units (Fig. 12A).

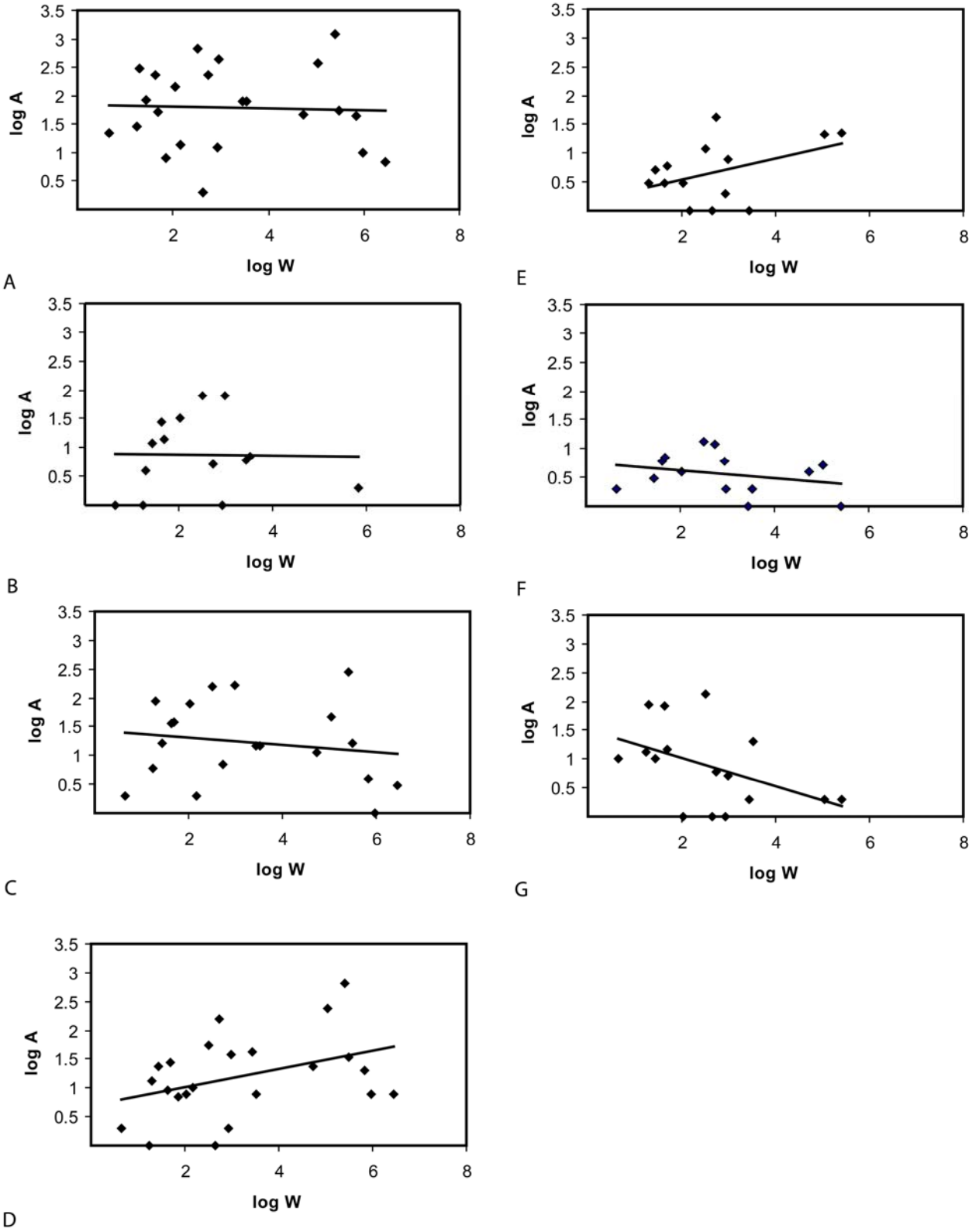
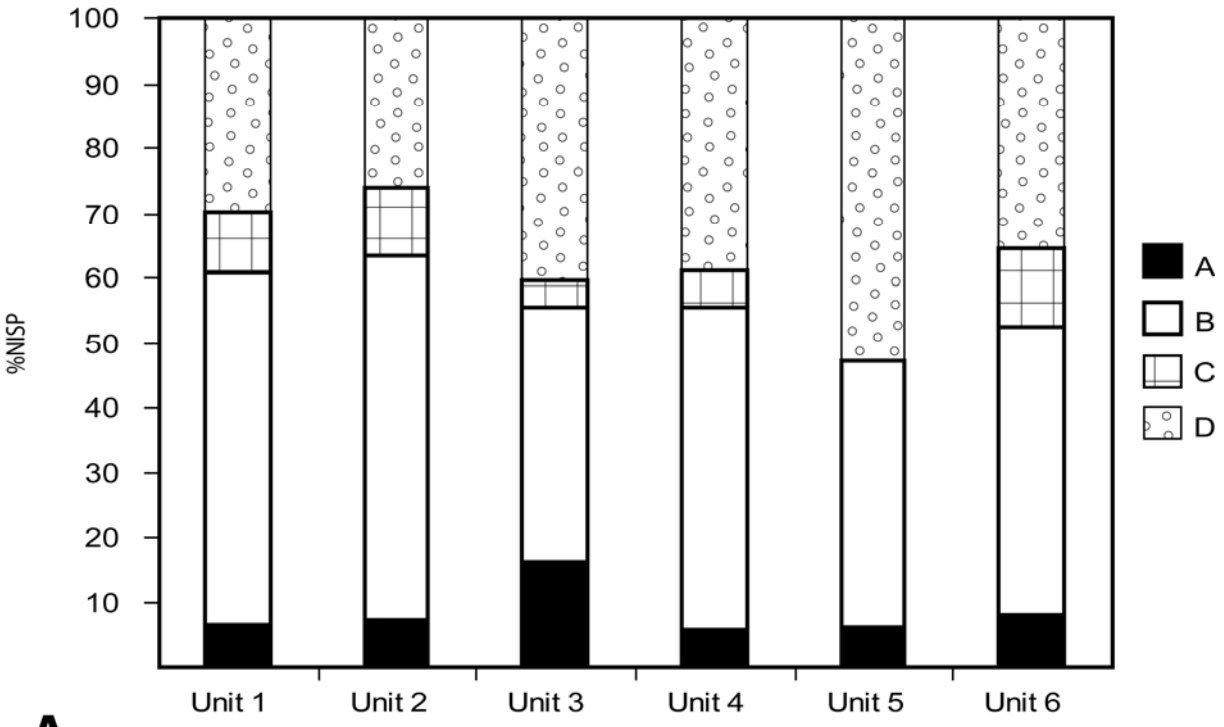
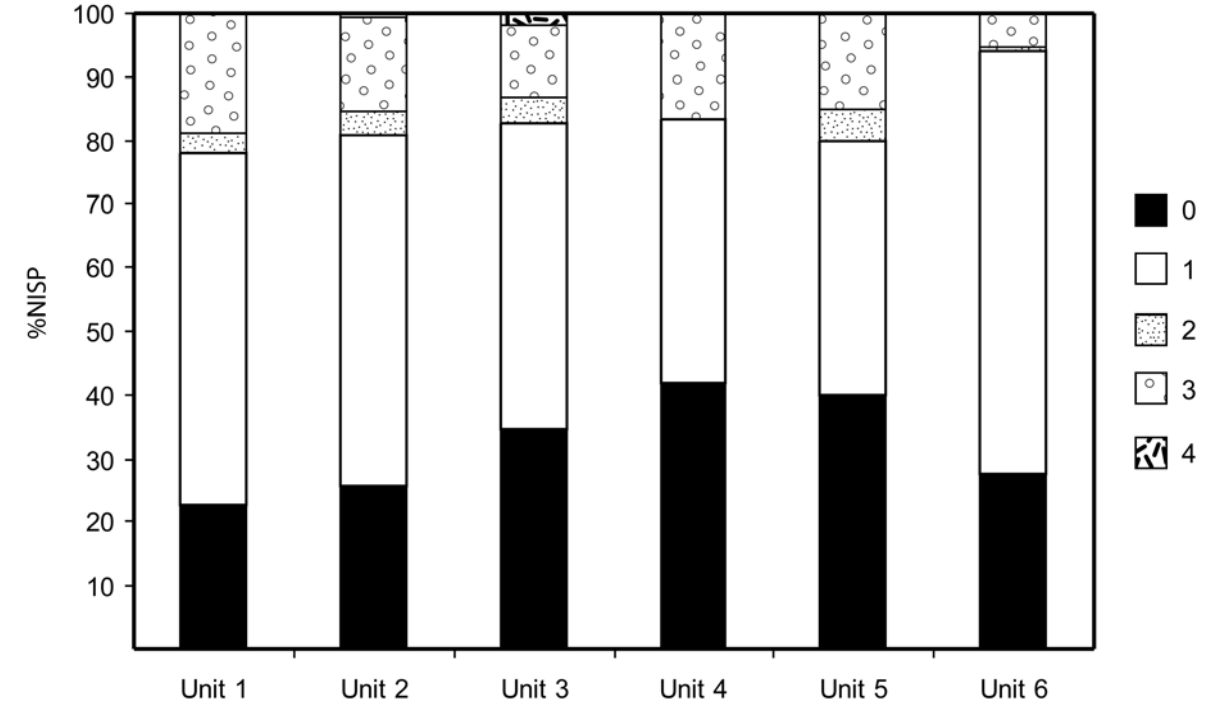


Figure 11. Regression of the logarithm of taxon abundance (log A) on the logarithm of taxon median weight (log W) for pooled data and each stratigraphic unit. A = pooled data, B = Unit 1, C = Unit 2, D = Unit 3, E = Unit 4, F = Unit 5, G = Unit 6.

Ground squirrels (*Urocitellus* sp.) are the most fragmented taxon, with 100% of mandibles missing the ascending ramus. Only 2.5% of *Urocitellus* sp. specimens were mandibles however, while the majority were individual teeth. Pocket mice (*Perognathus* sp.) mandible fragmentation changed the most between sequences, ranging from 10–00%. The high Holocene mandible fragmentation for *Perognathus* is an artifact of low sample size (NISP = 1). All other rodent taxa have C and D damaged mandibles in a range from 29–83%.


100
90
80
70
60
50
40
30
20
10
%NISP
Unit 1
Unit 2
Unit 3
Unit 4
Unit 5
Unit 6
A
B
C
D

A


100
90
80
70
60
50
40
30
20
10
%NISP
Unit 1
Unit 2
Unit 3
Unit 4
Unit 5
Unit 6
0
1
2
3
4

B

Figure 12. (A) Behrensmeyer (1978) bone wear stages for mandibles from each unit within Natural Trap Cave. (B) Rodent Mandible fragmentation classes. Y-axis is % NISP within each age level.

The proportion of rodent mandibles lacking incisors is 40% for the pooled Natural Trap Cave assemblage. The proportion of mandibles lacking incisors increased from 55% within the Unit 5 to 83% in Unit 5, and then steadily decreased in the younger units. The lowest values were 33% in Units 1 and 2. Ground squirrels (*Urocitellus* sp.) maintain high mandible incisor loss percentages throughout (>50%) however (Fig. 12B).

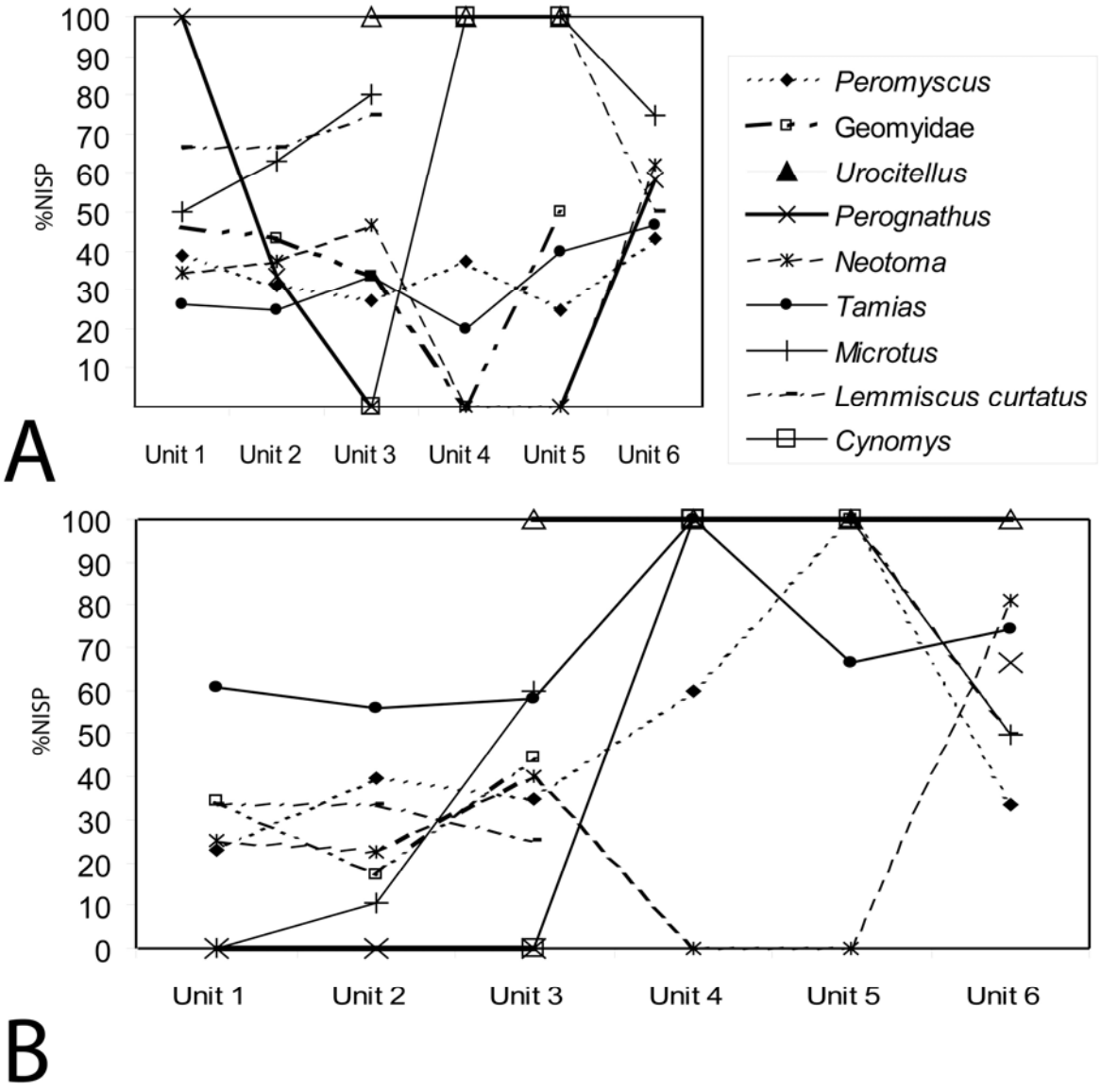


Figure 13. A: %NISP of jaws in fragmentation classes C and D within each taxon. B: %NISP rodent mandibular incisor loss by taxon.

The lagomorph data separate Units 3, 4, 5, and 6 from Units 1 and 2 (Fig. 13). Units 3, 4, and 5 contain lower %NISP of innominates and higher %NISP of tibias. Unit 6 has the highest %NISP of tibias (26%) while Unit 3 has the lowest %NISP of innominates (11%). Values for Units 4 and 5 for both of these elements are intermediate between Units 3, 6, and the younger units. Units 3 and 6 also have lower %NISP of mandibles than Units 1, 2, 4, and 5. Taxonomic

proportions of *Lepus* and *Sylvilagus* also change. The proportion of *Lepus* sp. in the lagomorph assemblage is higher in the older units than in the younger ones. Very few osteologically immature *Lepus* sp. elements were present in the older units also, while juvenile hares were more abundant in the two younger units. Total lagomorph bone fragmentation is high throughout the cave for all elements (Table 7).

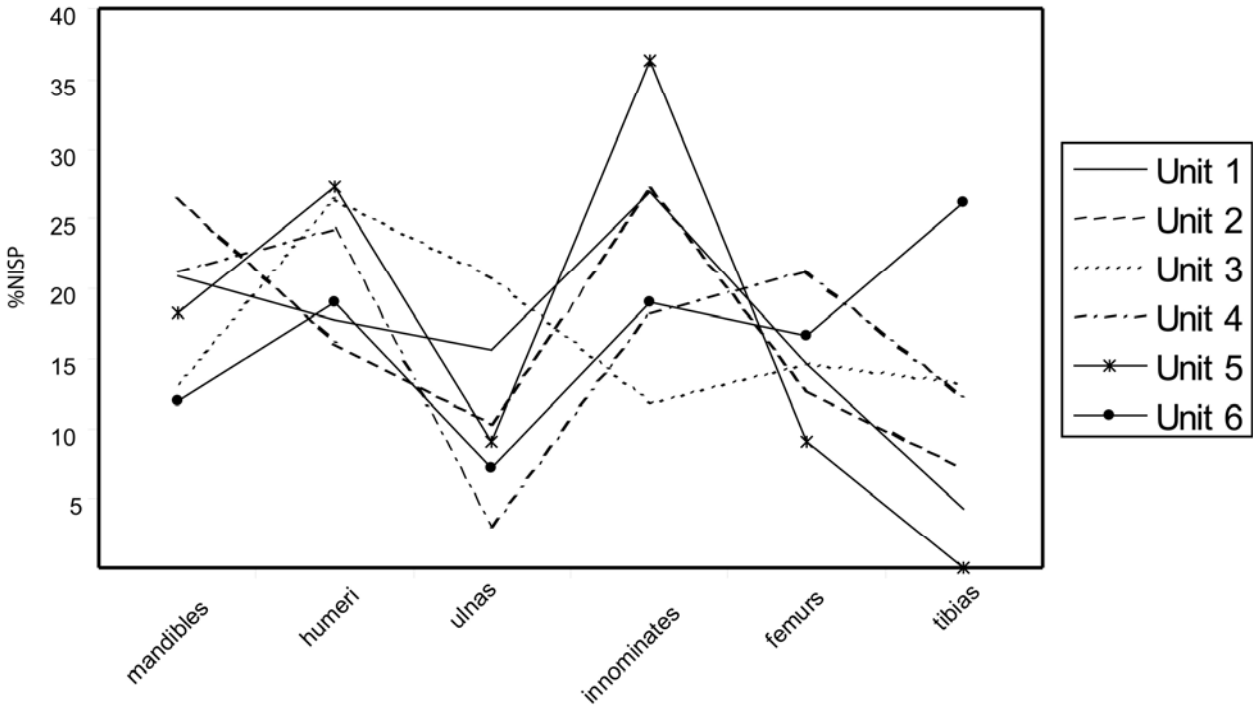


Figure 14. Lagomorpha %NISP of select cranial and postcranial elements.

Element	U1	% Com	U2	% Com	U3	% Com	U4	% Com	U5	% Com	U6	% Com
Hum.	11	22	23	31.9	14	36.8	3	37.5	0	0	1	12.5
Ulna	10	23.3	9	19.6	3	10.3	0	0	0	0	1	33.3
Inn.	21	27.6	29	23.8	1	14.3	4	66.7	1	25	5	62.5
Femur	6	14.6	9	15.8	4	10	2	28.6	0	0	1	14.3
Tibia	3	25	3	9.38	3	15.8	1	25	0	n/a*	2	18.2

Table 8. Lagomorph fragmentation patterns in the pelvis and selected long bones by stratigraphic unit. Abbreviations: U = stratigraphic unit NISP, % Com = % NISP complete, Hum. = Humerus, Inn. = Innominate. *No tibias were recovered from this Unit 5.

Relatively few small mammal bones display rodent gnawing (NISP = 73) and are present in Units 1, 2, 3, 5, and 6. The number of rodent-modified bones decreased with age, with the most occurring in Units 1 (NISP = 22) and 2 (NISP = 17).

Discussion

The size class distribution of a fossil fauna is a first approximation for possible taphonomic bias. Martin and Gilbert (1978) and Wang and Martin (1993) presented evidence that Natural Trap Cave acted as a pitfall trap for most of the large mammals, so a comparison of size class abundance can provide an indication of how much small mammal taphonomy differs from the pitfall trap model. Damuth (1981) reported an inverse relationship between size and abundance (slope of – 0.75) in modern mammal communities. In general, there are fewer members of large size classes than smaller ones in any given mammal community. Due to allometric size scaling in mammals, herbivores in fossil assemblages should be preserved in proportion to their relative abundances and turnover rates (Damuth, 1982). The general inverse relationship between size and abundance should be valid for unbiased fossil assemblages in the Pleistocene of North America because Damuth's (1981, 1982) regression held for a wide variety of modern habitats, including those that are analogous with North American Pleistocene communities.

The size distribution of the Natural Trap Cave mammal fauna is not representative of a modern community. The abundances of large mammals in Natural Trap Cave were similar to the small mammals in two units, greater than small mammals in two units, and somewhat less than small mammals in two units (Fig.10 B–G). Small mammals did outnumber large mammals in the interglacial stratigraphic units (1, 5, and 6), but not during the glacial units. Environmental and behavioral factors are more likely causes than taphonomy for the high abundance of large mammals within the full glacial strata (29–15 ka). Paleobotanical studies have shown that the predominant habitat type on Little Mountain changed over time from a habitat more favorable for a variety of herbivores during glacial periods, to a less favorable one during interglacial

periods. Wells (1983) found evidence in packrat middens from 40–27 kyr in age for the association of Limber Pine (*Pinus flexilis*) and spruce (*Picea engelmannii*), an association found 600–900 m in elevation above Natural Trap Cave today. The association of Limber Pine and spruce in the Natural Trap Cave valley indicates that there were at least patches of alpine coniferous forest ecosystem present. Analyses by Gilbert et al. (1980) and Johnson and Fredlund (1982) of the phytoliths and pollen found in the cave sediments found evidence for a taxonomically diverse steppe tundra in the area during the Wisconsinan Glacial Age. Both the phytolith and pollen analyses found the interglacial floras to be generally similar to the taxonomically depauperate, dry sagebrush steppe prevalent on Little Mountain today (Gilbert et al., 1980; Johnson and Fredlund, 1982). Therefore, the Little Mountain flora present during the Wisconsinan glacial age may have been able to support a larger standing biomass of herbivores than the interglacial flora.

Behavioral factors for individual species probably also played a role in the abundance of large mammals within Natural Trap Cave. Wang (1988) noted that 85% of the bighorn sheep (*Ovis canadensis*) in Natural Trap Cave are young adult males. Modern *Ovis canadensis* often roam unfamiliar territory in small bachelor groups, a behavior that is evidently reflected in Natural Trap Cave (Geist, 1971; Wang, 1988; Wang and Martin, 1993). Martin and Kadivar (unpubl. data) used tooth wear age groups to age the Natural Trap Cave *Equus* and found that only certain age groups were represented, evidence for a seasonal horse presence on Little Mountain. Martin and Gilbert (1978) reported a game trail close to the cave's entrance that due to the topography of the upper plateau was one of the few routes to descend to the Bighorn River from Little Mountain. The funneling of large herbivores between Little Mountain and the Bighorn River through this game trail could have caused a portion of the skewed size/abundance

distribution observed in units 2, 3, and 4. Therefore the small numbers and low diversity of large mammals in Units 1, 5, and 6 relative to Units 2, 3, and 4 was caused by the reduced numbers of large herbivores that used the route located next to Natural Trap Cave to move between the grazing lands on Little Mountain and those at lower elevations. Local extinction may have also played a minor role; there are no horses or bighorn sheep in Unit 1 (Holocene) of Natural Trap Cave, only bison. Horses and bighorn sheep are present in Units 5 and 6 (preglacial) however, so local extinction does not entirely account for the low abundances of large mammals in the interglacial units.

Habitat change does not account for the change in abundance of small mammals between units however. Small mammal abundances are mostly decoupled from changes in large mammal abundance between stratigraphic units. Other taphonomic variables correlate more closely with small mammal abundance than environment. Small mammal abundances are more highly correlated with the number of quadrats excavated in each unit ($r^2 = 0.38$). In addition to numbers of quadrats, small mammal abundance (exclusive of woodrats) is correlated with woodrat NISP ($r^2 = 0.64$). If the low numbers of small mammals relative to large mammals is not related to collecting bias, as suggested by the weak correlation with quadrats excavated, then woodrats could have been responsible for the small mammal assemblage through their scavenging activity.

A stronger collecting effort for small mammals could have strengthened the low correlation between the number of quadrats excavated and small mammal abundance if the bone bed was uniformly distributed. A subsection of each quadrat was water screened for small fossils, while large mammal bones were collected from the entire square. If the bones were distributed uniformly throughout each quadrat, then a collecting bias towards large mammal would have resulted. There is strong evidence for spatial bone clustering however, such that the

weak correlation between squares excavated and small mammal abundance would not change greatly even if all sediment in each quadrat had been water screened (Fig. 14A & 8B). The large mammal bones were distributed in clusters across quadrats (Fig. 14A). I examined the small mammal sample recovered from Unit 1 in each quadrat and also found evidence of a spatially clustered distribution for small mammals (Fig 14B). Some quadrats had a higher density of small mammals than others. I tested for the significance of the observed clustering using the sample variance to mean ratio, which was highly significant (79.82 ($p<0.01$)). Both the large and small mammals showed evidence of clustering, most likely due to the flowing water responsible for much of the sediment deposition within the cave (Albanese, unpublished report). Flowing water within the main room could be expected to move remains short distances, a few meters at most, forming clusters of bone. Dodson (1973) calculated the sequence and flow requirements of dispersal of small mammal bones in water. Dodson (1973) found that sequence of dispersal for individual bone types was similar to the transport classes formed by Voorhies (1969) for sheep bones. Dodson (1973) also found that a very low flow velocity was required to move small mammal bones. Rainwater runoff into the cave would have supplied the necessary flow to move small mammal bones and deposit them relatively quickly within meters of their starting point.

Transforming mammal abundances increased the fit of the Natural Trap Cave fossil data to modern size distribution models. I transformed abundance data in two ways: transforming abundances of all small mammals evenly and transforming abundances according to carcass representation in a modern fauna. In the evenly transformed abundance test, I multiplied NISP for each taxon by 24 to simulate a sample that could be expected if all sediments in a quadrat had been water screened and bone density was horizontally uniform in the unit. Performing this

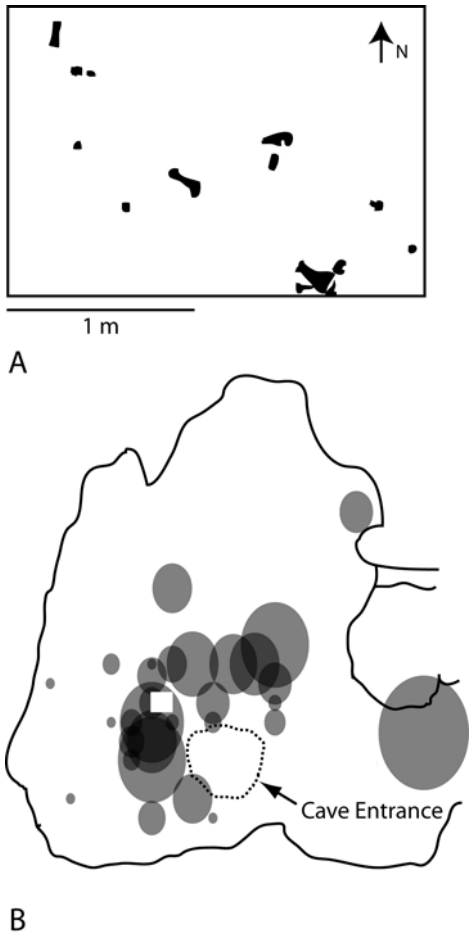


Figure 15. (A) Example of spatial bone distribution in quadrat 510NW515 A & B. Level shown is 30–38 cm below the first layer of the Middle sequence. The bones shown are mixed sheep and horse postcrania. (B) NISP per quadrat sampled for the Holocene sequence. Circle size represents NISP found in each quadrat.

operation resulted in no significant change in slope for any stratigraphic unit, so even if the distribution of bones were uniform, it could not account for the observed size distribution. It should be noted however that the application of a correcting factor for predepositional destruction of small taxa remains by weathering, scavenging, trampling, etc. yielded a regression slope closer to Damuth's (1982) analysis in every case. There is modern evidence for a bias against small vertebrates in conditions where they are not isolated from the predepositional

factors just listed. Behrensmeyer et al. (1979) found an overabundance of large mammals (>1000 kg) in a modern bone collection formed from surface remains in a Kenyan national park. The same size distribution has also been found in surface collections of birds (Behrensmeyer et al., 2003), which indicates a general preservation bias against small bones in open-air environments. Damuth (1982) suggested applying the correction factor derived from Behrensmeyer et al. (1979) if open-air taphonomic processes are suspected of acting in a fossil assemblage. I applied the correction factor to the taxon abundances in the Natural Trap Cave fauna and the results were all closer to the confidence limits for modern communities than the regression analysis focusing on collection bias alone ($r = -0.49$–-0.75). The application of the correction factor to abundances in Unit 6 resulted in an r-value of -0.97 ($p<0.01$), well within the 95% confidence limits of Damuth's (1982) regression model.

The marginal values observed in Units 1–5 are an indication that other taphonomic processes were also acting on small mammals in addition to preferential surface destruction of small carcasses. An additional size filter caused by woodrats is one possible hypothesis to account for the additional small mammal abundance transformation. Two studies of modern woodrat nests have found a common weight distribution in bones recovered from them. Hoffmann and Hays (1987) studied woodrat bone collecting behavior by leaving modern skeletons from different taxa ranging in size from deer to catfish (*Ictalurus* sp.) at an active Eastern Woodrat (*Neotoma floridana*) den. The individual elements of the Raccoon (*Procyon lotor*), domestic dog (*Canis familiaris*)(~15 kg live weight), and White-tailed Deer (*Odocoileus virginianus*) skeleton were weighed (Hoffmann and Hays, 1987). Hoffmann and Hays (1987) found that the woodrats in the den moved the most dog elements (75%), followed by Opossum (*Didelphis virginiana*) (65%), deer (55%), Box Turtle (*Terrapene carolina*) (43%), catfish

(41%), and raccoon (23%). In terms of weight, the woodrats preferred all weights of elements from the small domestic dog, heavier elements (>2.4 g) of a juvenile raccoon (*Procyon lotor*), and lighter elements (<30 g) of a White-tailed Deer, such that 89% of the bones moved weighed between 1 and 30 g (Hoffmann and Hays, 1987). Hockett (1989a) catalogued the weight distribution of a non-rodent bone collection made from a Bushy-tailed Woodrat (*Neotoma cinerea*) nest and found a similar proportion weighed between 1 and 30 g (78%). Woodrats therefore generally prefer median values in their weight range of bones. They will move elements as light as 0.1 g and as heavy as 101 g, but only in relatively small numbers. In Natural Trap Cave Units 1–5, the small mammal (<5 kg) size distribution is skewed towards taxa .3–1 kg in live weight (Fig. 15). *Sylvilagus* (median live weight = 939 g) are the most abundant small mammals in Units 1–2 and *Urocitellus* (median live weight = 542 g) are the most abundant in Units 3–5 when *Neotoma* are excluded. I weighed the limb bones, pelvis, and mandibles of *Sylvilagus* and found them to be comparable in weight (0.47–2.35 g) to the median weight elements of the raccoon used by Hoffmann and Hays (1987). The dominance of *Sylvilagus* and *Urocitellus* and paucity of smaller mammals is similar to *Neotoma* collecting patterns found in modern studies and may account for the additional taphonomic bias against small mammals in Units 1–5. There is currently not enough data to formulate a correction factor for woodrat bone collecting, but a linear regression of a study similar to that of Hoffmann and Hays (1987), in which the woodrats are given the choice of a wide variety of rodents and lagomorphs, may provide an approximation of such a factor. The size data in Natural Trap Cave suggests that woodrats were active bone collectors in Natural Trap Cave during the entire deposition of Units 1–5.

Woodrats probably provided the means of introducing bones and feces from the ridge and surrounding valley into the cave. Woodrats commonly collect bone as well as predator pellets and feces to bring these materials into their nests (Finley, 2005). Modern *Neotoma cinerea* commonly collect predator-modified bone and predator feces to incorporate in their middens to the extent that bone is just as common as plant matter in the midden (Finley, 1958; Hockett, 1989a). The bones brought into the midden commonly show signs of predator modification. Hockett (1989a) examined non-rodent bones from modern *N. cinerea* middens and found 51.3% to be predator-modified, while fewer were rodent-modified (14%). The proportion of rodent-modified bone found by Hockett (1989a) is comparatively similar to that observed in the Natural Trap Cave collection for Units 1–5, although predator-modified bone is much more rare. Only rodent and lagomorph bones were examined however, predator modification of these smaller taxa may be more rare given they are often swallowed whole. Hockett (1989a) also found three coyote scats in each of the six modern nests examined. Two possible coyote scats were recovered from Natural Trap Cave. Fecal matter is commonly observed adhered to small mammal bones in Unit 1 (Holocene). Woodrats certainly could have been a major accumulating agent in Natural Trap Cave Units 1–5.

The weight distribution observed in Unit 6 is different from that seen in Units 1–5 because there are a higher proportion of the smallest mammals in Unit 6 than stratigraphically younger units. The weight distribution is heavily left skewed in Units 1–5 and almost bimodal in Unit 6 (Fig. 15). The distributional change is also coupled with the highest NISP per quadrat of any Natural Trap Cave unit, 78.8, which is more than double that of the next highest unit. I infer from the bimodal weight representation and NISP/quadrat density that an avian predator roosting in the cave supplemented the collecting activity of woodrats during the deposition of Unit 6.

This is why Unit 6 is the only unit that had a regression line within the confidence limits of Damuth's (1981, 1982) modern mammalian community data following the use of a correction for preferential destruction of small carcasses. I believe the need for the surface destruction correctional factor indicates woodrat bone collecting from outside the cave was still an important component of bone accumulation in Unit 6.

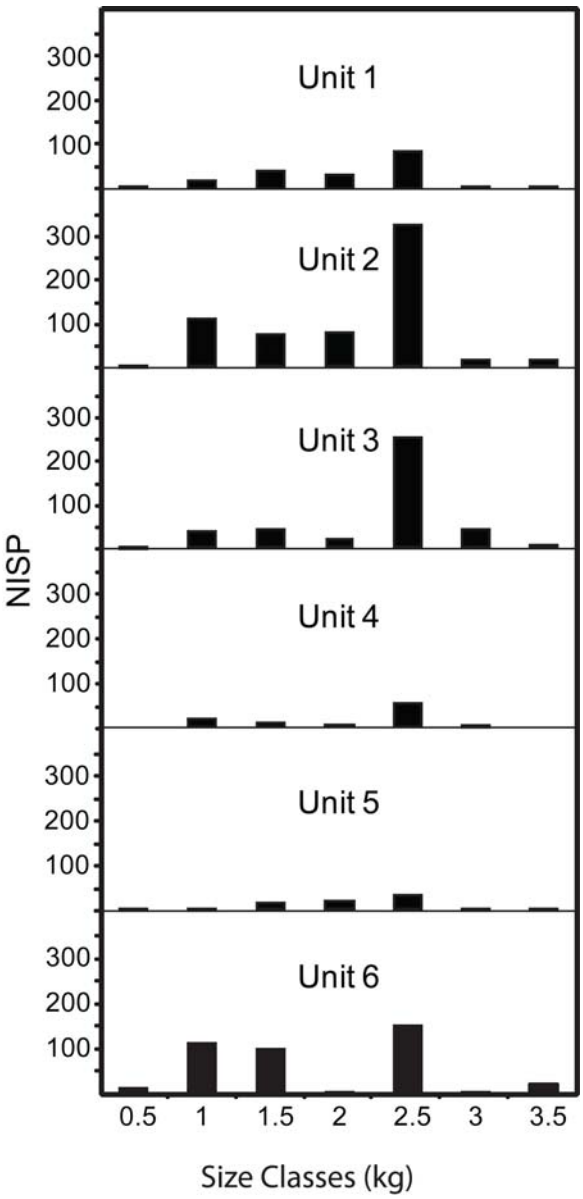


Figure 16. NISP/weight histograms for Natural Trap Cave stratigraphic units. Weight class limits correspond to log W listed in Table 3.

Postdepositional factors within Natural Trap Cave apparently had a minimal impact on the small mammal fauna. Small mammal remains have the same susceptibility to destruction through postdepositional factors, such as rock falls and sediment compaction, as large mammals. Element recovery in the Natural Trap Cave horses and bighorn sheep is correlated with mechanical strength of the bone such that the relatively dense and compact distal bones of the manus and pes were recovered more often than proximal limb elements (Wang and Martin, 1993). A similar pattern was not found in the small mammal taxa for which postcranial data is available, the leporids. In the leporid skeleton, the femur is generally a denser and more robust bone than the humerus (Pavao and Stahl, 1999). If mechanical strength played a role in element recovery, then the relative proportion of humeri in the sample should decrease with age and the proportion of femurs should increase (Fig. 13). This is not the case in any Natural Trap Cave unit because humeri always form a higher proportion of each unit total than femurs. Mechanical strength therefore did not play a large role in small mammal element recovery.

I infer from the need for a correction factor for small mammals and large mammal abundances into proper proportion, even in the units with very few large mammals, that the small mammals recovered from Natural Trap Cave died outside before being transported in for much of the cave's depositional history. Woodrat scavenging of bone from carcasses and predator feces from the surface is the most likely route for the introduction of the small mammal bones to the main room of Natural Trap Cave. Natural Trap Cave is not located in a depression, so the prevailing topography would have washed carcasses located more than ~ 10 m from the entrance away from the opening. Carcasses and feces being washed into the cave through the entrance were probably an infrequent event at best. Natural Trap Cave is inaccessible to non-volant predators, but the roosting of an avian predator in the cave is a possibility though, especially for

Unit 6. Woodrat scavenging is a more likely route for the introduction of the small mammals for Units 1–5.

I believe that bone weathering also provides evidence against the washing in of small mammal carcasses from the surface. Large mammal bones deposited directly in the cave provide an example of the expected bone weathering distribution for cave accidentals. Wang and Martin (1993) found that the majority of large mammal bones were in weathering stage 1, only lightly weathered. Woodrats can relatively quickly move an entire skeleton, so the proportion of highly weathered bones in a woodrat midden is also expected to be light (Hoffmann and Hays, 1987). I noted that the weathering of bones in 2 middens protected by rock overhangs in the valley next to Natural Trap Cave. In these protected middens most bones bore light weathering in the form of surface cracks and some were still greasy. Elements in valley middens not protected from the elements were dried out and had longitudinal cracks. The majority of Natural Trap Cave small mammal bones are in weathering stages zero and one with only slight weathering (Fig. 11B). Bone weathering allows me to further negate the role of rainwater washing in carcasses as a route of entry for small mammals in Natural Trap Cave. Bones washed in would have had a less skewed distribution with more representation in the advanced wear stages than is observed in the Natural Trap Cave small mammals.

Possible predators

While the proportions of small mammals present in Natural Trap Cave may only reflect the collecting preference of woodrats, the taxonomic representation should not have been affected. The types of mammal remains that woodrats can come into contact with would vary depending on the types of predators that frequented the area around Natural Trap Cave. I compared each taxon to damage classes of modern predators and then catalogued local

representatives of those damage classes that have been documented to include those small mammal taxa in their diets (Table 8).

Pocket gophers (Geomyidae), deer mice (*Peromyscus*), pocket mice (*Perognathus*), and woodrats are the most likely owl-accumulated taxa. Each of these rodent taxa has 20–60% of jaws missing the ascending ramus and <50% missing incisors, similar to the proportions observed for small rodents in modern owl pellet assemblages (Dodson and Wexlar, 1979; Andrews, 1990; Kusmer, 1990). I have discounted the high incisor loss values for *Peromyscus* within Unit 4 and Unit 5 as a sampling artifact due to a small sample ($n \leq 5$ in both cases). These taxa are found in the diet of all owls of the central Rocky Mountains (Table 8). Ravens and mammalian predators also take pocket gophers, deer mice, and woodrats. Hawks and eagles do not commonly eat pocket mice, but do take the other taxa mentioned (Table 8).

Chipmunks (*Tamias*) were taken by a different owl taxon than that stipulated for the rodents discussed above. The chipmunks have a high incisor loss proportion (57–72%), but low

Taxa	Predators	References
Sorex (shrews)	Northern Harrier (*Circus cyaneus*), Red-tailed Hawk (*Buteo jamaicensis*), Rough-legged Hawk (*Buteo lagopus*), American Kestrel (*Falco sparverius*), Barn Owl (*Tyto alba*), Eastern Screech Owl (*Megascops asio*), Great Horned Owl, Northern pygmy Owl (*Glaucidium gnoma*), Great Gray Owl (*Strix nebulosa*), Long-eared Owl (*Asio otus*), Short-eared Owl (*Asio flammeus*), Boreal Owl (*Aegolius funereus*), Northern Saw-whet Owl (*Aegolius acadius*), Common Raven (*Corvus corax*), American Marten (*Martes americana*), Coyote (*Canis latrans*), Bobcat (*Lynx rufus*)	Sperry, 1941; Craighead and Craighead, 1956; Murie, 1961; Weckwerth and Hawley, 1962; Long and Kerfoot, 1963; Maser and Brodie, 1966; Smith and Wilson, 1971; Smith et al., 1972; Temple, 1974; Craig and Trost, 1979; Boula, 1982; Zielinski et al., 1983; Franklin, 1988; Marks and Doremus, 1988; Bull et al., 1989a; Bull et al., 1989b; Young and Engel, 1989; Koehler and Hornocker, 1991; Stiehl and Trautwein, 1991; Hayward et al., 1993; Holt and Leroux, 1996; Lyman et al., 2003
Sorex nanus (Pygmy Shrew)	Barn Owl	Martin, 1971
Ochotona (pika)	Prairie Falcon (*Falco mexicanus*), Boreal Owl, weasels (*Mustela* spp.), American Marten, Coyote	Quick, 1951; Murie, 1961; Krear, 1965; Marti and Braun, 1974; Hayward et al., 1993

Taxa	Predators	References
Brachylagus idahoensis (Pygmy Rabbit)	Long-eared Owl, Bobcat	Borell and Ellis, 1934; Gashwiler et al., 1960.
Sylvilagus nuttallii/*audubonii* (Cottontail Rabbits)	Northern Harrier, Swainson's Hawk (*Buteo swainsoni*), Red-tailed Hawk, Golden Eagle (*Aquila chrysaetos*), Bald Eagle (*Haliaeetus leucocephalus*), Prairie Falcon, Barn Owl, Great Horned Owl, Long-eared Owl, Common Raven, Black-footed Ferret (*Mustela nigripes*), Badger (*Taxidea taxus*), Coyote, Bobcat	Borell and Ellis, 1934; Nelson, 1934; Orr, 1940; Sperry, 1941; Spencer, 1943; Hall, 1946; Craighead and Craighead, 1956; Gashwiler et al., 1960; Long and Kerfoot, 1963; Maser and Brodie, 1966; Marti, 1969; Knight and Erickson, 1977; Messick and Hornocker, 1981; Springer and Smith, 1981; Collopy, 1983; Campbell et al., 1987; Martin, 1987; Steenhoff and Kochert, 1988; Steenhof and Kochert, 1989; Phillips et al., 1990; Koehler and Hornocker, 1991; Kralovec et al., 1992; Camp et al., 1993; Zimmerman et al., 1996; Kristan et al., 2004
Lepus sp. (hares)	Northern Goshawk (*Accipiter gentilis*), Swainson's Hawk, Red-tailed Hawk, Golden Eagle, Bald Eagle, Great Horned Owl, Long-eared Owl, Common Raven, Coyote, American Marten, Black-footed Ferret, Lynx (*Lynx canadensis*)	Cameron, 1908; Sperry, 1941; Craighead and Craighead, 1956; Muri, 1961; Weckwerth and Hawley, 1962; Long and Kerfoot, 1963; Saunders, 1963; Van Zyll de Jong, 1966; Temple, 1974; Marti, 1976; Knight and Erickson, 1977; Springer and Smith, 1981; Zielinski et al., 1983; Swenson et al., 1986; Campbell et al., 1987; Kralovec et al., 1992; Camp et al., 1993; Zimmerman et al., 1996; Kristan et al., 2004.
Lepus arcticus (Arctic Hare)	Gyrfalcon (*Falco rusticolus*), Arctic Fox (*Alopex lagopus*), Red Fox (*Vulpes vulpes*), Lynx	Soper, 1944; Kennedy, 1980; Muir and Bird, 1984; Hearn et al., 1987; Poole and Boad, 1988.
Lepus californicus (Black-tailed Jackrabbit)	Rough-legged Hawk, Golden Eagle, Bald Eagle, Common Raven, Badger, Bobcat	Orr, 1940; Gashwiler et al., 1960; Messick and Hornocker, 1981; Collopy, 1983; Eakle and Grubb, 1986; Steenhof and Kochert, 1988, Stiehl and Trautwein, 1991; Kralovec et al., 1992.
Tamias (*Neotamias*) (Western Chipmunks)	Great Horned Owl, Great Gray Owl, Boreal Owl, Common Raven, Coyote, American Marten, weasels	Nelson, 1934; Sperry, 1941; Quick, 1951; Murie, 1961; Weckwerth and Hawley, 1962; Maser and Brodie, 1966; Zielinski et al., 1983; Bull et al. 1989a; Koehler and Hornocker, 1991; Hayward et al., 1993.
Tamias minimus (Least Chipmunk)	Northern Goshawk, Cooper's Hawk (*Accipiter cooperii*), Red-tailed Hawk, American Kestrel, Prairie Falcon, Coyote, Badger	Craighead and Craighead, 1956; Craig and Trost, 1979; Messick and Hornocker, 1981; Springer and Smith, 1981; Squires et al., 1989.
Marmota (marmots)	Red-tailed Hawk, American Marten, Coyote	Sperry, 1941; Craighead and Craighead, 1956; Murie, 1961.

Taxa	Predators	References
Marmota flaviventris (Yellow-bellied Marmot)	Golden Eagle, Bald Eagle, Prairie Falcon, Great Horned Owl, Common Raven, Coyote, American Marten, Badger, Black Bear (*Ursus americanus*), Bobcat	Couch, 1930; Verbeek, 1965; Marti, 1969; Marti and Braun, 1974; Andersen and Johns, 1977; Knight and Erickson, 1977; Messick and Hornocker, 1981; Collopy, 1983; Zielinski et al., 1983; Swenson et al., 1986; Stiehl and Trautwein, 1991; Van Vuren, 2001.
Spermophilus sp. (*sensu lato*, ground squirrels)	Northern Goshawk, Cooper's Hawk, Swainson's Hawk, Red-tailed Hawk, Ferruginous Hawk (*Buteo regalis*), Golden Eagle, Bald Eagle, Gyrfalcon, American Kestrel, Prairie Falcon, Common Raven, Coyote, American Marten, weasels, Badger, Lynx, Bobcat	Sperry, 1941; Quick, 1951; Craighead and Craighead, 1956; Gashwiler et al., 1960; Murie, 1961; Weckwerth and Hawley, 1962; Van Zyll de Jong, 1966; Dorn, 1972; Marti and Braun, 1974; Messick and Hornocker, 1981; Springer and Smith, 1981; Wells and Beckoff, 1982; Collopy, 1983; Eakle and Grubb, 1986; Zielinski et al., 1983; Swenson et al., 1986; McLaren et al., 1988; Poole and Boad, 1988; Steenhof and Kochert, 1988; Engel and Young, 1989; Squires et al., 1989; Steenhof and Kochert, 1989; Koehler and Hornocker, 1991; Stiehl and Trautwein, 1991; Kralovec et al., 1992; Camp et al., 1993; Gese et al., 1996; Parke, 2004.
Urocitellus richardsonii/*elegans* (Richardson's/Wyoming Ground Squirrel	Northern Goshawk, Swainson's Hawk, Red-tailed Hawk, Ferruginous Hawk, Golden Eagle, Prairie Falcon, Coyote, Badger, Lynx	Borell and Ellis, 1934, Sperry, 1941; Van Zyll de Jong, 1966; Pfeifer, 1980a; Pfeifer, 1980b; Springer and Smith, 1981; Fagerstone, 1982; McLaren et al., 1988.
Cynomys sp. (prairie dogs)	Golden Eagle, Bald Eagle, Red-tailed Hawk, Ferruginous Hawk, Great Horned Owl, Coyote, weasels, Badger	Cameron, 1908; Spencer, 1943; Longhurst, 1944; Quick, 1951; Tileston and Lechleinter, 1966; Marti, 1969; Phillips et al., 1990; Kralovec et al., 1992.
Cynomys leucurus (White-tailed Prairie Dog)	Red-tailed Hawk, Ferruginous Hawk, Golden Eagle, Bald Eagle, Prairie Falcon, Black-footed Ferret, Badger, Coyote, Bobcat	Sperry, 1941; Gashwiler et al., 1960; Tileston and Lechleinter, 1966; Campbell et al., 1987; McLaren et al., 1988; Kralovec et al., 1992.
Thomomys sp. (pocket gopher)	Northern Goshawk, Swainson's Hawk, Red-tailed Hawk, American Kestrel, Great Horned Owl, Great Gray Owl, Long-eared Owl, Common Raven, American Marten, weasels, Badger, Coyote	Nelson, 1934; Sperry, 1941; Quick, 1951; Craighead and Craighead, 1956; Murie, 1961; Maser and Brodie, 1966; Roth and Powers, 1979; Messick and Hornocker, 1981; Zielinski et al., 1983; Young and Engel, 1989; Stiehl and Trautwein, 1991; Kristan et al., 2004.
Thomomys talpoides (Northern Pocket Gopher)	Swainson's Hawk, Red-tailed Hawk, Ferruginous Hawk, Golden Eagle, Bald Eagle, American Kestrel, Prairie Falcon, Barn Owl, Great Horned Owl, Great Gray Owl, Burrowing Owl (*Athene cunicularia*), Long-eared Owl, Boreal Owl, Northern Saw-whet Owl, Common Raven, Coyote, American Marten, Long-tailed Weasel (Mustela frenata), Badger, Bobcat	Criddle, 1930; Weckwerth and Hawley, 1962; Long and Kerfoot, 1963; Hansen and Ward, 1966; Marti, 1969; Maser et al., 1971; Dorn, 1972; Marti and Braun, 1974; Knight and Erickson, 1977; Craig and Trost, 1979; Springer and Smith, 1981; Boula, 1982; Wells and Beckoff, 1982; Gleason and Johnson, 1985; Grimm et al., 1985; Janes and Barrs, 1985; Swenson et al., 1986; Franklin, 1988; Bull et al., 1989a; Bull et al.,

Taxa	Predators	References
		1989b; Koehler and Hornocker, 1991; Hayward et al., 1993; Zimmerman et al., 1996.
Perognathus sp. (pocket mice)	Barn Owl, Long-eared Owl, Burrowing Owl, Northern Saw-whet Owl, Common Raven, Coyote, Badger, Bobcat	Borell and Ellis, 1934; Sperry, 1941; Gashwiler et al., 1960; Marti, 1969; Maser et al., 1971; Craig and Trost, 1979; Roth and Powers, 1979; Messick and Hornocker, 1981; Springer and Smith, 1981; Boula, 1982; Gleason and Johnson, 1985; Grimm et al., 1985; Engel and Young, 1989; Stiehl and Trautwein, 1991; Camp et al., 1993
Peromyscus sp. (deer mice)	Northern Harrier, Rough-legged Hawk, Red-tailed Hawk, American Kestrel, Prairie Falcon, Barn Owl, Eastern Screech Owl, Great Horned Owl, Northern Pygmy Owl, Great Gray Owl, Long-eared Owl, Short-eared Owl, Burrowing Owl, Boreal Owl, Northern Saw-whet Owl, Common Raven, Coyote, American Marten, weasels, Black-footed Ferret, Badger, Bobcat	Sperry, 1941; Quick, 1951; Craighead and Craighead, 1956; Gashwiler et al., 1960; Muri, 1961; Weckwerth and Hawley, 1962; Long and Kerfoot, 1963; Maser and Brodie, 1966; Marti, 1969; Maser et al., 1971; Smith and Wilson, 1971; Smith et al., 1972; Marti and Braun, 1974; Fitzner and Fitzner, 1975; Craig and Trost, 1979; Roth and Powers, 1979; Messick and Hornocker, 1981; Springer and Smith, 1981; Boula, 1982; Zielinski et al., 1983; Gleason and Johnson, 1985; Grimm et al., 1985; Campbell et al., 1987; Martin, 1987; Franklin, 1988; Marks and Doremus, 1988; Bull et al., 1989a; Bull et al., 1989b; Engel and Young, 1989; Koehler and Hornocker, 1991; Stiehl and Trautwein, 1991; Camp et al., 1993; Hayward et al., 1993; Kaufman et al., 1993; Gese et al., 1996; Holt and Leroux, 1996; Zimmerman et al., 1996; Kristan et al., 2004
Neotoma sp. (woodrat)	Golden Eagle, American Kestrel, Barn Owl, Great Horned Owl, Long-eared Owl, Common Raven, Badger, Coyote, Bobcat	Widmann, 1896; Sperry, 1941; Gashwiler et al., 1960; Maser and Brodie, 1966; Marti, 1969, Eakle and Grubb, 1966; Marti, 1976; Messick and Hornocker, 1981; Stiehl and Trautwein, 1991; Camp et al., 1993; Kristan et al., 2004
Neotoma cinerea (Bushy-tailed Woodrat)	Red-tailed Hawk, Golden Eagle, Long-eared Owl, Boreal Owl, Coyote, American Marten, Bobcat	Borell and Ellis, 1934; Weckwerth and Hawley, 1962; Collopy, 1983; Bull et al., 1989b; Koehler and Hornocker, 1991; Hayward et al., 1993

Taxa	Predators	References
Microtus sp. (vole)	Northern Harrier, Northern Goshawk, Sharp-shinned Hawk (*Accipiter striatus*), Cooper's Hawk, Swainson's Hawk, Red-tailed Hawk, Rough-legged Hawk, Golden Eagle, American Kestrel, Prairie Falcon, Barn Owl, Eastern Screech Owl, Great Horned Owl, Burrowing Owl, Northern Pygmy Owl, Long-eared Owl, Great Gray Owl, Short-eared Owl, Boreal Owl, Northern Saw-whet Owl, Common Raven, Coyote, American Marten, weasels, Bobcat, Lynx	Borell and Ellis, 1934; Sperry, 1941; Quick, 1951; Craighead and Craighead, 1956; Gashwiler et al., 1960; Long and Kerfoot, 1963; Maser and Brodie, 1966; Van Zyll de Jong, 1966; Dorn, 1972; Smith et al., 1972; Temple, 1974; Springer and Smith, 1981; Collopy, 1983; Zielinski et al., 1983; Grimm et al., 1985; Martin, 1987; Franklin, 1988; Bull et al., 1989b; Koehler and Hornocker, 1991; Stiehl and Trautwein, 1991; Hayward et al., 1993; Gese et al., 1996; Holt and Leroux, 1996; Kristan et al., 2004
Microtus longicaudus (Long-tailed Vole)	Prairie Falcon, Barn Owl, Great Gray Owl, Short-eared Owl, American Marten, Ermine (*Mustela erminea*)	Hayward, 1949; Weckwerth and Hawley, 1962; Marti and Braun, 1974; Fitzner and Fitzner, 1975; Roth and Powers, 1979; Bull et al., 1989
Microtus ochrogaster (Prairie Vole)	American Kestrel, Barn Owl, Great Horned Owl, Burrowing Owl, Long-eared Owl, Coyote	Tordoff, 1955; Long and Kerfoot, 1963; Marti, 1969; Kaufman et al., 1993
Microtus miurus (Singing Vole)	Gray Wolf (*Canis lupus*), Wolverine (*Gulo gulo*), Least Weasel (*Mustela nivalis*)	Bee and Hall, 1956
Microtus montanus (Montane Vole)	American Kestrel, Barn Owl, Great Horned Owl, Northern Pygmy Owl, Burrowing Owl, Great Gray Owl, Short-eared Owl, Northern Saw-whet Owl, Common Raven, Black-footed Ferret, Badger	Maser et al., 1971; Fitzner and Fitzner, 1975; Craig and Trost, 1979; Roth and Powers, 1979, Messick and Hornocker, 1981; Boula, 1982; Gleason and Johnson, 1985; Campbell et al., 1987; Franklin, 1988; Marks and Doremus, 1988; Bull et al., 1989a; Engel and Young, 1989; Holt and Leroux, 1996
Lemmiscus curtatus (Sagebrush Vole)	Great Horned Owl, Burrowing Owl, Long-eared Owl, Common Raven, Coyote, Black-footed Ferret	Long and Kerfoot, 1963; Maser et al., 1971; Dorn, 1972; Marti, 1976; Springer and Smith, 1981; Campbell et al., 1987; Stiehl and Trautwein, 1991
Dicrostonyx sp. (collared lemming)	Gyrfalcon, Arctic Fox	MacPherson, 1969; Kennedy, 1980; Muir and Bird, 1984
Dicrostonyx groenlandicus (Bering Collared Lemming)	Gyrfalcon, Snowy Owl (*Bubo scandiacus*), Common Raven, Arctic Fox	Bee and Hall, 1956; Temple 1974; Poole and Boad, 1988

Table 9. Common modern predators of the fossil rodents and lagomorphs found in Natural Trap Cave based on modern observation, stomach content, or scat studies.

mandible fragmentation (24–48%). The higher incisor loss values in Unit 4 may be an artifact caused by a small sample size ($n < 5$). Andrews (1990) found a similar pattern in three European scat assemblages made by Short-eared Owl (*Asio flammeus*), European Eagle Owl (*Bubo bubo*),

and Great Grey Owl (*Strix nebulosa*). Pellet remains from these owls have relatively low mandible fragmentation and high incisor loss, possibly because of greater bone digestion (Andrews, 1990). The Great Gray Owl is among the North American predators of chipmunks, so this is a possible predator for this taxon for Natural Trap Cave (Table 8). Great Gray Owls hunt during the night, morning, evening, and even during the day in some cases, thus overlapping the daily activity cycle of chipmunks (Brunton and Pittaway, 1971). Ravens (*Corvus corax*) are also a likely *Tamias* predator, because they inflict a similar amount of damage to incisors (61.5% missing in modern pellets collected from central Europe) (Laudet and Silva, 2005). Chipmunks have only been recorded in the diet of North American Common Raven once however (Nelson, 1934). Nelson (1934) reported the presence of chipmunk remains in a single raven nest, most likely representing a single kill. Chipmunks are relatively common in Natural Trap Cave, so owls seem more likely as chipmunk predators for the Natural Trap Cave sample.

Lemmiscus curtatus has medium mandible fragmentation (50–78%) and low mandible incisor loss (33–50%). The pellets of small owls, such as the Palearctic Little Owl (*Athene noctua*), exhibit high bone fragmentation with little digestive damage done to teeth because the small owl must partially dismember large prey before swallowing (Andrews, 1990). Similar sized owls in North America, such as the Eastern Screech Owl (*Megascops otus*), are also more destructive than larger owls (Dodson and Wexlar, 1979). Burrowing Owls (*Athene cunicularia*) are relatively small and are common sagebrush vole predators (Table 8). The Natural Trap Cave *Lemmiscus* were probably accumulated by an owl taxon, such as the Burrowing Owl, smaller than that responsible for the other owl-collected rodents. Therefore, at least two different owl taxa contributed to the accumulation of Natural Trap Cave rodents.

The voles (*Microtus*) are the taxon that was likely taken by different predators at different times. I infer from the medium levels of mandible fragmentation and incisor loss that the >21 kyr *Microtus* were predominantly raven (*Corvus corax*) accumulated, while the younger voles were from owl pellets. A larger diurnal raptor that could eat a vole without having to dismember it is another possibility. Voles are commonly found in raven pellets, a variety of diurnal raptor pellets, as well as the pellets of most North American owl taxa (Table 8).

The large sciurids had medium–high amounts of bone modification indicating accumulation by diurnal raptors and mammalian carnivores. Marmots (*Marmota*) had less damage, while prairie dogs (*Cynomys*) and ground squirrels (*Urocitellus*) had more. These sciurids are medium-large and diurnal, and are therefore the least likely to be taken by nocturnal owls. *Marmota* dentaries examined did not show the high mandible fragmentation and erosion, or large numbers of isolated teeth indicative of mammalian carnivore feeding and digestion, although they could be from partial carcasses cached by a mammalian predator and later recovered by woodrats. A complete marmot skull was recovered from the cave floor surface and partial associated skeleton of a juvenile Yellow-bellied Marmot (*Marmota flaviventris*) was recovered from Unit 3, so this is a possibility. With the amount of damage observed, diurnal raptors such as the Golden Eagle (*Aquila chrysaetos*) are more likely as a predator for the marmots. The *Cynomys* dentaries show medium levels of damage, similar to that seen in large squirrels (*Sciurus*) consumed by modern ravens (*Corvus corax*) in Europe (Laudet and Silva, 2006). Ravens are not known as predators of *Cynomys* however, therefore the prairie dogs were more likely to be accumulated by a diurnal raptors such as Golden Eagle (*Aquila chrysaetos*) and buteos (Table 8). *Urocitellus* sp. is primarily represented by a large number of isolated teeth, and therefore is most comparable to mammalian predator accumulations. Almost all isolated

teeth are from well-worn adults, so they are from mandibles that were fractured and digested by the predator, not by weathering processes as would be expected if they were primarily juveniles. The few dentaries present are highly fragmented, lack incisors (Fig. 12A & B), and show signs of digestion. There are three modern predators common to the sciurids discussed above (Table 8): Golden Eagles, Prairie Falcons (*Falco mexicanus*), coyotes (*Canis latrans*), and bobcats (*Lynx rufus*). Given the complete nature of the marmots, Golden Eagles are the most likely predator for *Marmota*. Coyotes or bobcats seem to be the most likely predator for *Urocitellus* because of the fragmentary nature of the material, although small falcons like the Prairie Falcon are also a probable predator. Either eagles or the mammalian predators could have contributed the prairie dogs, although the medium levels of damage seen in the prairie dogs suggests the eagles are more likely.

Dicrostonyx (Collared Lemming) is common on the modern arctic tundra. *Dicrostonyx* is represented in Natural Trap Cave by teeth alone, so these rodents are also more likely to have been the diet of mammalian predators. Modern tundra predators include (Table 8): Snowy Owl (*Bubo scandiacus*), Gyrfalcon (*Falco rusticolus*), Common Raven (*Corvus corax*), and Arctic Fox (*Alopex lagopus*). Of these predators, only the Common Raven has been reported from Natural Trap Cave (Martin and Gilbert, 1978). Collared Lemmings are represented in the cave by isolated teeth only, so there is stronger evidence for a mammalian than an avian predator. Red Fox (*Vulpes vulpes*) has been reported from Natural Trap Cave (Martin and Gilbert, 1978) and the Red Fox diet overlaps with Arctic Foxes in localities where they are sympatric, although the former usually relies less on the latter's typical prey items (Elmhagen, et al., 2002). Therefore, the Red Fox may have served as a predator of *Dicrostonyx* when the lemming was available with its Pleistocene range.

The fauna of Unit 6 is especially important for the identification of a possible predator because that predator must have roosted in the cave, and was therefore avian, and had a preference for the lighter taxa noted in Figure 15. The bimodality observed in the left side of the Unit 6 histogram was caused by relatively high NISP in two taxa, deer mice (*Peromyscus*) and chipmunks (*Tamias*).

Leporid analysis

Taxon and element representation are important elements in predator analysis of leporid remains, but the activity of woodrats could potentially obscure the predator's taphonomic signature. *Neotoma* must have collected a proportion of the leporids in Natural Trap Cave because leporid postcranial elements constitute 50% of the cave's woodrat-modified bone. The participation of woodrats being a known variable, I sought to determine to what extent the woodrats biased the leporid collection. The weight bias towards elements of median weight by woodrats noted by Hoffmann and Hays (1987) could bias taxonomic representation towards the heavier of the two leporid genera, *Lepus*, and element representation biased towards elements weighing >1g. I weighed elements from modern representatives of *Sylvilagus audubonii* (Desert Cottontail), *S. nuttallii* (Mountain Cottontail), *Lepus townsendii* (White-tailed Jackrabbit), and *L. californicus* (Black-tailed Jackrabbit) to determine if there was a weight bias in the leporids similar to that observed by Hoffmann and Hays (1987). Of the elements considered, only the ulna in *Sylvilagus* weighs <1 g. Of the two genera considered, *Lepus* had the heaviest elements. The *Lepus* humerus, pelvis, femur, and tibia fall within the weight range of raccoon elements that Hoffmann and Hays (1887) observed a woodrat preference for. I tested for a correlation between weight and element abundance in each stratigraphic unit using Kendall's tau and corrected for multiple tests using the Bonferroni correction. Weight and element abundance is uncorrelated in

Units 1, 2, and 6 ($p < 0.05$), while in Units 3, 4, and 5 these variables were correlated. Weight and element were uncorrelated in Units 1 and 2 because the lighter *Sylvilagus* elements make up a higher proportion of the leporid fauna than *Lepus*. The Unit 6 leporid postcrania are primarily composed of *Lepus*, but the abundance of these elements is uncorrelated to weight. No weight bias similar to that observed by Hoffmann and Hays (1987) was observed and therefore the action of woodrats did not bias the leporid element or taxonomic representation, except in Units 3, 4, and 5.

I found the leporid taphonomic pattern indicates avian predators are the most likely accumulators of the assemblage, but different avian predators were most likely responsible for the lagomorphs at different times. The lack of tibias and the abundance of mandibles Units 1, 2, and 5 is a pattern found in modern coyote (*Canis latrans*) scat assemblages (Table 7; Fig. 13). Coyotes, and mammalian predators in general, typically fragment leporid bone to the point that complete bones are not represented in scat (Andrews and Evans, 1983; Schmitt and Juell, 1994). Schmitt and Juell (1994) observed that even low-meat sections of the carcass that are not consumed and left at the kill site are highly fragmented. Units 1, 2, and 5 have a higher proportion of complete bones than is typical of coyotes. Most small and medium raptors that consume leporids also leave relatively intact tibia at roosts and nesting sites as well (Schmitt, 1995). Therefore, Units 1, 2, and 5 were more likely the result of hawk, falcon, or owl feeding rather than coyotes. The pattern observed in Unit 5 is suspect in any case because this unit has a particularly small sample size ($n = 11$) and a possible woodrat collecting bias. Stratigraphic Unit 3 was also probably the result of a falcon, buteo, or owl. The dominance of anterior limbs (humeri and ulnas) in Unit 3 is most similar to Barn Owl (*Tyto alba*) pellet assemblages (Hockett, 1991). Great Horned Owls (*Bubo virginianus*) utilize leporids, both *Sylvilagus and*

Lepus, to a much greater extent than Barn Owls however (Long and Kerfoot, 1963; Marti, 1969; Zimmerman et al., 1996). Therefore the leporid taphonomic evidence corroborates the other small mammal evidence for use of the area by Great Horned Owls.

The increase in posterior limb elements, especially tibias, in Units 4 and 6 indicates a large raptor as the main predator (Schmitt, 1995). As mentioned above, the correlation of weight and element representation in Unit 4 indicates the possibility of woodrat bias in that layers. Unit 6 had no correlation with woodrat collecting and the taphonomic signature there is not altered. The proportion of hares increases in the lower levels, especially in Unit 6, so a larger raptor such as the Golden Eagle would be a more likely predator than the smaller hawks, falcons, and owls evident in the younger units (Table 8).

Taphonomic change

Natural Trap Cave Units 1, 2, and 3 (25–0 ka) differ taphonomically from units 4, 5, and 6 (>100–25 ka). Units 1, 2, and 3 have evidence of accumulation by owls, diurnal raptors, and mammalian predators. Rodents in Units 1–3 show the clearest evidence of owl accumulation—low mandible damage and generally low incisor loss. The one exception is mammalian predator-accumulated *Urocitellus*, because of their highly fragmented jaws and high incisor loss. Leporids in units 1, 2, and 3 also appear to be attributable to owls, although falcons and hawks are also a possibility. Units 1, 2, and 3 also contain abundant fish, mostly catfish, and small waterfowl remains (rails, small ducks, grebes, etc.). Both Bald Eagles (*Haliaeetus leucocephalus*) and Golden Eagles (*Aquila chrysaetos*) include fish and small waterfowl in their diet, but Bald Eagles rely too a much greater extent on these prey items than do Golden Eagles (Olendorff, 1976; Kralovec et al., 1992; Swenson et al., 1986). In summary, Units 1–3 have significant evidence for the participation of avian predators (owls and diurnal raptors).

Units 4–6 have evidence for all three types of predators. The highly fragmented nature of the ground squirrels present within Units 4 and 5 implicates mammalian predators. Mandible fragmentation and incisor loss was relatively low for most other rodent taxa, still within the range observed in modern owl assemblages. The shift towards lighter weight prey species in Unit 6 caused by the increased abundance of chipmunks and deer mice is evidence for an owl roosting in the cave. In Units 4–6 there are no waterfowl or fish, which is evidence for Bald Eagles (*Haliaeetus leucocephalus*), but the leporid evidence points to a large diurnal raptors as the primary accumulator of rabbits and hares during this stratigraphic interval. There was no major change in the nearest permanent water source, so environmental change does not seem to be a factor. The youngest abandoned oxbows nearest Natural Trap Cave are at least 350 kyr in age (Stock et al., 2006). These abandoned oxbows are at the confluence of the Bighorn River and Porcupine Creek. Known as the Natural Corrals, these oxbows are now high on the cliff wall. The nearest source of water for the aquatic taxa has therefore never been any closer than 4 km to Natural Trap Cave during the cave's deposition, so a change in eagle diet brought on by habitat change is not likely. Based on the lack of aquatic taxa and relative abundance of hares in Units 4–6, the Golden Eagle (*Aquila chrysaetos*) was therefore present during their deposition.

Units 4 and 5 are also notable for their dearth of material. Despite representing 80% of the time covered during the deposition of the cave, these units only account for 6% of the fossil material. This may be partially due to the smaller area excavated within these units, but even less area was excavated for Unit 6 and it accounts for 12% of the total collection. The excavated areas of Unit 4 and 5 may have missed areas of concentrated bone however. There is significant evidence for the spatial clustering of small mammals in Unit 1, with areas immediately underneath, north, and east of the main entrance yielding the most fossil material. Units 4 and 5

were predominantly excavated west of the main entrance, so more material from these units may be concentrated in unexcavated areas. Given the evidence for woodrat nesting in Units 1–5, woodrat abundance in the area may account for the low total NISP in Units 4 and 5. The density of woodrat elements per quadrat is lowest in Units 4 and 5. Lower amounts of woodrats would result in fewer elements being brought into the cave and this is the pattern observed.

Predator bias in prey selection and hunting radius

The hunting range of the predator as well as the type of prey they prefer biases fossil assemblages created by predators. The contribution of avian predators to the formation of the Natural Trap Cave small mammal assemblage implies a large collecting radius, but the variety of predators probably negated the prey preference bias. The action of woodrats added an additional filter, but probably a beneficial one, because prey remains from several different predator taxa were deposited in the cave that may have otherwise provided suitable den habitat for fewer taxa. Due to their larger possible hunting ranges, the collecting radius of the raptor taxa can be used to set a maximum collecting radius of the cave.

I analyzed home range estimates of raptors whose modern range includes the Big Horn Mountains as well as the Common Raven to suggest a possible collecting radius for Natural Trap Cave. Modern raptor home range size increases with body mass and with the density of prey (Peery, 2000). Common Ravens are opportunistic omnivores, and have correspondingly small mean range (8.2 km^2) (Linz et al., 1992). Owls specialize in small mammals, so their home ranges tend to be smaller than bird-hunting taxa (Peery, 2000). The Long-eared Owl (*Asio otus*) has the largest mean home range (13.9 km^2) of all modern owls in the Big Horn Mountains (Peery, 2000). The small mammal taxa that were interpreted as raven or owl accumulated therefore came from within a 4 km radius of Natural Trap Cave. Large and small catfish remains

in Natural Trap Cave Units 1–3 are further evidence for a minimum-collecting radius of 4 km, which is the distance to the Bighorn River (Fig. 1).

The Prairie Falcon has the largest home range (341.87 km^2) of likely falconiform predators and was therefore set as the maximum collecting radius for the cave (Peery, 2000). This is an indication that some of the leporid and large sciurid material may have come from elevations much higher or lower than Natural Trap Cave.

The distance woodrats forage from their nests inside Natural Trap Cave would affect the number of raptor roosting sites and nests the rats would have access to. The foraging range of woodrats from their nest is well known. In a study of Colorado *Neotoma cinerea*, Finley (1990) was able to collect examples of 70% of plant species found in the midden within 30 m of the nest. A study of *Neotoma floridana* using the tinfoil ball method showed a home range of 52 m from the den (Ireland and Hays, 1969). If the *Neotoma* enter Natural Trap Cave through lateral limestone fissures as suggested by Rushin (1973), then the woodrats could have collected from the surface of the small ridge surrounding the cave entrance as well as the rock walls and slopes of the surrounding valley. The valley wall provides roosts for ravens and hawks today and undoubtedly did so in the past as well.

Maximum dimensions of objects that can be transported by woodrats are also a taphonomic factor. A field study by Hockett (1989a) found that the largest object that *Neotoma cinerea* could carry into a nest was 295X11 mm and weighed 54.5 g. Average dimensions are much smaller however, 98X3 mm and a weight of 16 g (Hockett, 1989a). Given the tight dimensions of the presumed entrance to Natural Trap Cave for the woodrats, the average dimensions given by Hockett (1989a) are probably the maximum object size that can be brought into a midden in the cave. Pellets and feces of common raptors and mammalian carnivores

sampled by Andrews (1990) are smaller than these maximum dimensions, so woodrats could have easily transported them inside the cave.

Conclusions

Large and small herbivores exhibit different taphonomic patterns within Natural Trap Cave as shown by the under representation of the small mammals. Small mammals are under represented in Natural Trap Cave, but multiplying taxon abundances by a correction factor formulated for surface taphonomic processes changed the abundance/weight distribution of Natural Trap Cave Unit 6 to within the confidence limits of modern mammal faunas. Marginal regressions observed in Units 1–5 are most likely caused by the additional weight-based taphonomic bias of woodrat bone collecting. *Neotoma* likely transported a large proportion of the small mammal remains, either in scats and pellets or as individual elements, into the cave. I conclude that the *Neotoma*-collected elements were brought close to the cave by owls, mammalian carnivores, eagles, hawks, falcons, and possibly ravens. A shift towards lighter small mammal taxa and an increase in bone density in Unit 6 is evidence that a predator, possibly Great Horned Owl (*Bubo virginianus*), nested directly in the cave. Low proportions of rodent jaw fragmentation and incisor loss strongly supports the presence of owl predation. *Microtus* >21 kyr in age had higher proportions of mandible damage, so the more destructive raven or diurnal raptors may have been the primary vole predator in the lower levels. Owls, hawks, falcons, and eagles accounted for the leporids in Natural Trap Cave. Mammalian predators accounted for the *Urocitellus*, although the Prairie Falcon is also a known ground squirrel predator.

Some taphonomic change was observed between the older and younger strata. Units 3, 4, and 6 have leporid taphonomic patterns different from younger levels. In the case of the lagomorphs, there was a switch from Golden Eagles in the older strata to smaller raptors in the younger layers. The absence of fish and waterfowl in Units 4, and 6, which Bald Eagles include

in their diet more often than other potential raptors, also indicates that the Golden Eagle is the more likely candidate for the leporid predator in the older stratigraphic units.

I conclude from the evidence for a variety of avian predators that the collecting radius of Natural Trap Cave at the very least covers all of Little Mountain and the adjoining stretch of the Bighorn River. Contribution to the cave's fossil assemblage from a variety of avian predators and some mammalian predators also shows that bias from predator prey selection is not a problem for faunal change interpretation. Furthermore, there is no complete turnover in the dominant predator type between strata, mammalian and avian predators were always contributing to some extent. Therefore the collecting radius of the cave probably remained steady at approximately 4 km.

CHAPTER 4

Testing for paleocommunity stasis in Natural Trap Cave

Community stasis in Quaternary North American mammals has primarily been studied on large scales. While Brett and Baird (1995) characterized coordinated stasis as a phenomenon of the regional ecosystem and not the local community, coordinated stasis should leave a recognizable signature on a local community. The first response of a community's component species to environmental change is habitat tracking (Eldredge, 2003). Therefore, a static fossil locality would record a local community as a biofacies when the community moved through the area tracking its preferred habitat. This would result in a pattern of biofacies recurrence in a single locality. The neglect of local faunas is also forced by the nature of fossil deposition, either due to a lack of chronologic control or because the fauna does not cover a time span long enough to record biofacies change. Those that have analyzed faunal change in one locality (Porcupine Cave by McGill et al., 2005) have not addressed variables that could confound results, particularly local variability species distributions. Bennington and Bambach (1996) and Bennington (2003) noted that patchiness in the spatial distribution of benthic marine communities could result in unforeseen variability in samples taken from the same outcrop. Replicate sampling in Quaternary localities is often not available however. Fortunately, the taphonomy of fossil deposition in cave sites can be expected to blur living community patchiness to a certain degree through time averaging and multiple methods of deposition such that several community types near the cave are sampled. Hadley (1996) found this to be the case in the late Holocene record from Lamar Cave, Yellowstone National Park, Wyoming. Taphonomy may change over longer time intervals however, whether through changes in a cave's topography or a turnover in predators using the cave as shelter, and result in a change in taxa present in the fauna.

Natural Trap Cave offers a chance to study coordinated stasis on a local scale while still addressing the issues of taphonomy and patchiness. Natural Trap Cave has chronologic control and depth, the cave fauna covers the last glacial cycle (~100 kyr–present). There are no major taphonomic breaks within the fauna, the small mammals were primarily accumulated by owls, diurnal raptors, and mammalian carnivores in the immediate vicinity of the cave and then transported into the cave by woodrats (*Neotoma*). The area surrounding Natural Trap Cave offers replicate sampling to analyze the effect of patchiness on faunal composition. Prospects Shelter, located ~200 m south of Natural Trap Cave has a small mammal fauna that spans the last glacial maximum and deglaciation. (84–18 ka). Eagle Shelter, located 1.2 km NW of Natural Trap Cave, has not been sampled as extensively, but offers a small Holocene fauna that can be qualitatively compared to Natural Trap Cave (Chomko, 1982). Juniper Cave, which is located on the valley wall opposite Prospects Shelter, also preserved a Holocene and late Pleistocene fauna, although the earliest Holocene and much of the last glacial maximum is not preserved in the cave (Kelly et al., 2002). A Holocene small mammal fauna was collected in Hole-in-the-Wall Shelter, located on the eastern side of Little Mountain (Fig. 1), from a raptor guano deposit, the bottom of which dated to 1307 ± 38 cal yr BP (Chomko, 1980).

Materials and Methods

Excavation methods

Natural Trap Cave (NTC) was excavated using stratified random squares. The cave floor was divided into a series of 2.3 m^2 quadrats, several of which were chosen at random for excavation. Initial excavation was done in 15.24 cm arbitrary levels, while subsequent excavations followed the natural stratigraphy. Large mammal bones were mapped at each excavation level before removal. A subsection of each level (30.48 cm X 30.48 cm X 15.24 cm) was saved for waterscreening (see Martin and Gilbert, 1978 for more on excavation methods). The small mammals in this study were collected primarily from the water-screened samples.

Eagle Shelter and Prospects Shelter were excavated at the same time as Natural Trap Cave and in a similar manner. In Eagle Shelter, six 1m^2 quadrats were excavated in 10 cm levels, with 25% of each level saved for waterscreening (Chomko, 1982). Four 1m^2 squares were excavated in Prospects Shelter and screened for microfauna, although the proportion saved for waterscreening was not specified (Chomko, 1978; Chomko and Gilbert, 1987). Three 1m^2 quadrats were excavated in Juniper Cave with all sediment sifted through 1/8-inch screens (Kelly et al., 2002). The Hole-in-the-Wall Shelter excavation was done on a pyramidal-shaped accumulation of avian feces and pellets underneath a roost. The deposit was sampled in 20 cm intervals, with the bottom sample radiocarbon dated (Chomko, unpubl. data).

Taxonomy

Identifications for the faunal list were usually made to genus due to the need for additional work in Prospects Shelter, Juniper Cave, and Hole-in-the-Wall Shelter and to increase taxon sample size within Natural Trap Cave levels. Identifications to species were only made

when there were characters readily available that did not require morphometric techniques to differentiate.

More detailed systematic work has been done on Natural Trap Cave and found one species dominated the record for each genus throughout the record (Williams, unpubl. data), so there is no evidence for complete replacement of one species by a congener.

Data analysis

An array of multivariate ordination and significance tests were used to analyze the samples from Little Mountain. Excel 2000 and PAST (PAleontological STatistics) were used for all statistical analyses (Hammer et al., 2001).

Sufficient sampling of each locality is necessary to adequately represent the local paleocommunity. To determine whether diversity was impacted by sample size, I calculated a rarefaction curve for the largest samples, NTC and Prospects Shelter, and then used the locality that most thoroughly sampled local diversity to compare the sample size and diversity of the smaller localities to (see Krebs, 1989 for details on the algorithm). To test sampling within levels of NTC, I plotted sample size and diversity for each level. Plotting the sample size and diversity of the following groups for each sample tested for the impact of taphonomy on taxonomic group representation: soricids, lagomorphs, cricetids, heteromyids, geomyids, and the sciurids.

The first issue addressed was local geographic variability, or "patchiness", in the community that the preserved paleocommunity represents. Patchiness in the local small mammal community would result in a type 2 error, failure to recognize stasis. To test for this, I compared abundance data between two Natural Trap Cave units and their correlated levels in Prospects shelter. Natural Trap Cave (NTC) Unit 2 (18–15 ka) was compared with Prospects

Shelter (PS) stratum III and NTC unit 3 (25–21 ka) was compared with uppermost PS stratum IV. The coefficient of constancy (C_c) was used to evaluate similarity between the two NTC units and their correlated PS strata because C_c incorporates presence/absence data weighted by abundance. The coefficient of constancy is the proportion or number of samples of a community that contain a particular species (McIntosh, 1985). C_c weights each taxon relative to its abundance in the pooled assemblage. It penalizes sample comparisons severely for mismatched abundant taxa, while rare taxa that are only present in one sample result in a minimal value loss. For a group of *n* samples with *r* species, the C_c is calculated by Eq. 1:

$$C_c=(\Sigma P_j \times k_j)/n \quad (1)$$

The maximum value of C_c is 1.0, the result if all samples contain identical numbers and kinds of species. The minimum value of C_c is $1/n$, where *n* is the number of samples being compared. Significance of the pairwise comparisons was determined by boostrapping each set of abundance distributions. In each analysis, the samples were pooled to generate an estimate of the species abundance distributions that both samples were drawn from. Random data points were drawn from each distribution to regenerate the original number and size of samples from which a new coefficient was calculated. I repeated this process 1,000 times and compared the observed index with values in the lower 5% of the bootstrapped index distributions. If the observed value met or exceeded the values in the lower 5%, then the original samples were judged similar enough to have been drawn from the same distribution.

The Bray–Curtis dissimilarity index, modified for presence-absence data, was used as the metric for measuring differences between samples. The Bray–Curtis index has been demonstrated though simulation to be a robust measure of community dissimilarity (Faith et al., 1987). For two samples *i* and *j* the index is calculated by Eq. 2:

$BC_{ij} = (b+c)/(2a+b+c)$ (2)

where *a* is the number of taxa shared by both samples, *b* is the number restricted sample *i*, and *c* is the number restricted to sample *j*. Two matrices of BC values were constructed from the presence–absence data, one for a Q-mode analysis and one for R-mode. The initial BC matrices were constructed with all taxa and an additional set was constructed with rare taxa removed. The probability of sampling rare taxa is small (Buzas et al., 1982; Koch, 1987), so removing any taxon that only occurred in only one sample tested for this effect. This resulted in one taxon removed, the harvest mouse (*Reithrodontomys* sp.), and did not change the significance of any comparisons or any ordinations. BC dissimilarity matrix patterns were ordinated using cluster analysis and non-metric multidimensional scaling (NMDS). I then used Kruskal–Wallis nonparametric analysis of variance (ANOVA) and analysis of similarity (ANOSIM) to evaluate differences within sites and time, and also between times.

The samples were grouped temporally based on the dates from each. I used multiple samples per time interval to test for the effect of spatial variability on taxon representation. There was no replicate sample for the >100 ka time interval, so NTC6 was grouped with the Holocene sites for most tests because of similar taxon membership.

Nonparametric significance tests were used because the geographic proximity of the samples resulted in a right skewed distribution of BC values. Kruskal–Wallis nonparametric ANOVA was used to detect overall differences that were then investigated using pairwise Mann-Whitney tests corrected for multiple comparisons. In each case the parametric ANOVA yielded the same result as the nonparametric test. Clarke (1993) designed the ANOSIM procedure as a nonparametric alternative to the MANOVA for multivariate ecological datasets. ANOSIM starts by ranking the BC values from the dissimilarity matrix, which is followed by calculating the

mean rank of values that represent comparisons within groups (r_w) and those that represent comparisons between groups (r_b). The statistic R is then calculated as:

$$R=(r_b-r_w)/[n(n-1)/4] \quad (3)$$

R can vary between 1 and –1, with values close to 1 indicating strong differences between groups and values near –1 indicating a strong difference within groups. Values near zero suggest the factor by which samples were grouped caused no difference (Clarke, 1993). The statistical significance of the R-statistic is then determined using a permutation procedure. PAST also displays the significance of Bonferroni-corrected pairwise comparisons.

Two ordination techniques were used to visually compare the samples: cluster analysis and non-metric multidimensional scaling (NMDS). The ranks of faunas and taxa were clustered using unweighted pair-group average (UPGMA), and then analyzed to find groups of taxa responsible for faunal clustering. I then used NMDS to rank the faunas in a continuous format. NMDS ranks the samples in a distance matrix and ordinates them in 3-dimensional space such that the Euclidean distances on the plot reflect the original ranks (Kruskal, 1964). The degree to which the ordination accurately reflects the original ranked distances is termed "stress." NMDS then uses a Monte Carlo routine to iteratively change the location of the data points to reduce the stress value. I ran the routine with twenty different starting points and chose the 3-dimensional plot that resulted in the lowest stress values.

Results

The cumulative faunal list from the Little Mountain rockshelter/cave record includes 21 taxa (Table 9). Total diversity is lowest within the Holocene localities and levels/localities >29 kyr in age, 13 and 15 taxa respectively. Diversity is the highest (17–19) in localities within the 29–15 kyr time span, which is also the interval with the largest sample size. Although only recorded to genus in several cases, the diversity count is probably representative of the total diversity on Little Mountain through time. Cottontail rabbits (*Sylvilagus*), hares (*Lepus*), and five-triangle voles (*Microtus*) may include more taxa than are recognized here. Morphometric

Taxa	PSIII	PSIV	NTC1	NTC2	NTC3	NTC4&5	NTC6	JC	HWS
Sorex hoyi	1	0	1	2	2	0	6	0	0
Sorex nanus	0	1	0	0	0	2	4	0	0
Ochotona sp.	1	1	0	2	11	1	0	1	0
Brachylagus idahoensis	0	0	0	0	0	1	1	0	0
Sylvilagus sp.	0	22	80	164	48	10	6	0	5
Lepus sp.	2	5	7	15	9	2	20	7	2
Perognathus sp.	1	7	1	6	1	0	13	0	0
Thomomys sp.	24	26	31	78	14	7	1	7	14
Marmotini cf. *Urocitellus*	275	202	5	7	198	53	6	17	0
Cynomys sp.	4	10	1	0	11	8	1	0	0
Marmota sp.	103	189	6	15	33	2	2	29	0
Tamias sp.	12	16	27	36	18	9	84	0	0
Phenacomys intermedius	2	11	0	0	0	0	0	0	0
Synaptomys borealis	6	9	0	0	0	0	0	0	0
Peromyscus sp.	15	14	4	89	16	3	87	7	18
Reithrodontomys sp.	0	0	0	0	0	0	7	0	0
Neotoma sp.	193	337	79	156	80	25	135	16	5
Microtus sp.	152	124	14	37	40	13	15	16	20
Microtus ochrogaster	0	2	0	3	1	1	0	0	0
Lemmiscus curtatus	130	124	12	16	30	8	10	5	1
Dicrostonyx sp.	16	0	0	0	7	0	0	0	0
Total	937	1100	268	626	519	145	398	105	65

Table 10. Taxonomic list for all Little Mountain Samples. NTC = Natural Trap Cave, PS = Prospects Shelter, JC = Juniper Cave, HWS = Hole-in-the-Wall Shelter. Counts are NISP (Number of Individual Specimens).

analysis of the NTC sample has shown there may be as many as two Cottontail rabbits, three hares, and three five-triangle *Microtus* species. These additional taxa are rare, represented by <5 specimens, and are only found in one level/locality.

Prospects Shelter and Natural Trap Cave (NTC) were the two largest samples (Table 9). Rarefaction of the Natural Trap Cave sample showed it has a more complete sample of the local diversity than Prospects Shelter, with a smaller sample but a similar number of taxa. The rarefaction curve for NTC flattens to the right indicating that sampling of local small mammal taxonomic diversity is mostly complete (Fig. 16). All localities are very close to the cumulative NTC rarefaction curve, although the sites with faunas that do not cover 29–15 kyr occupy the left side of the curve. Most taxonomic groups are adequately sampled in each locality (Fig. 4), although the smaller samples lack soricids and heteromyids while Hole-in-the-Wall Shelter (HWS) additionally lacked sciurids.

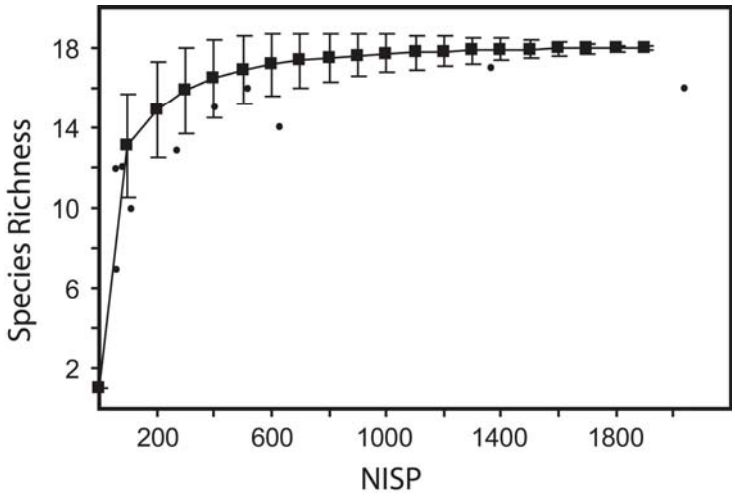


Figure 17. Rarefaction curve for the cumulative Natural Trap Cave site. Error bars denote two standard deviations. Dots represent the individual units of Natural Trap Cave and all other localities.

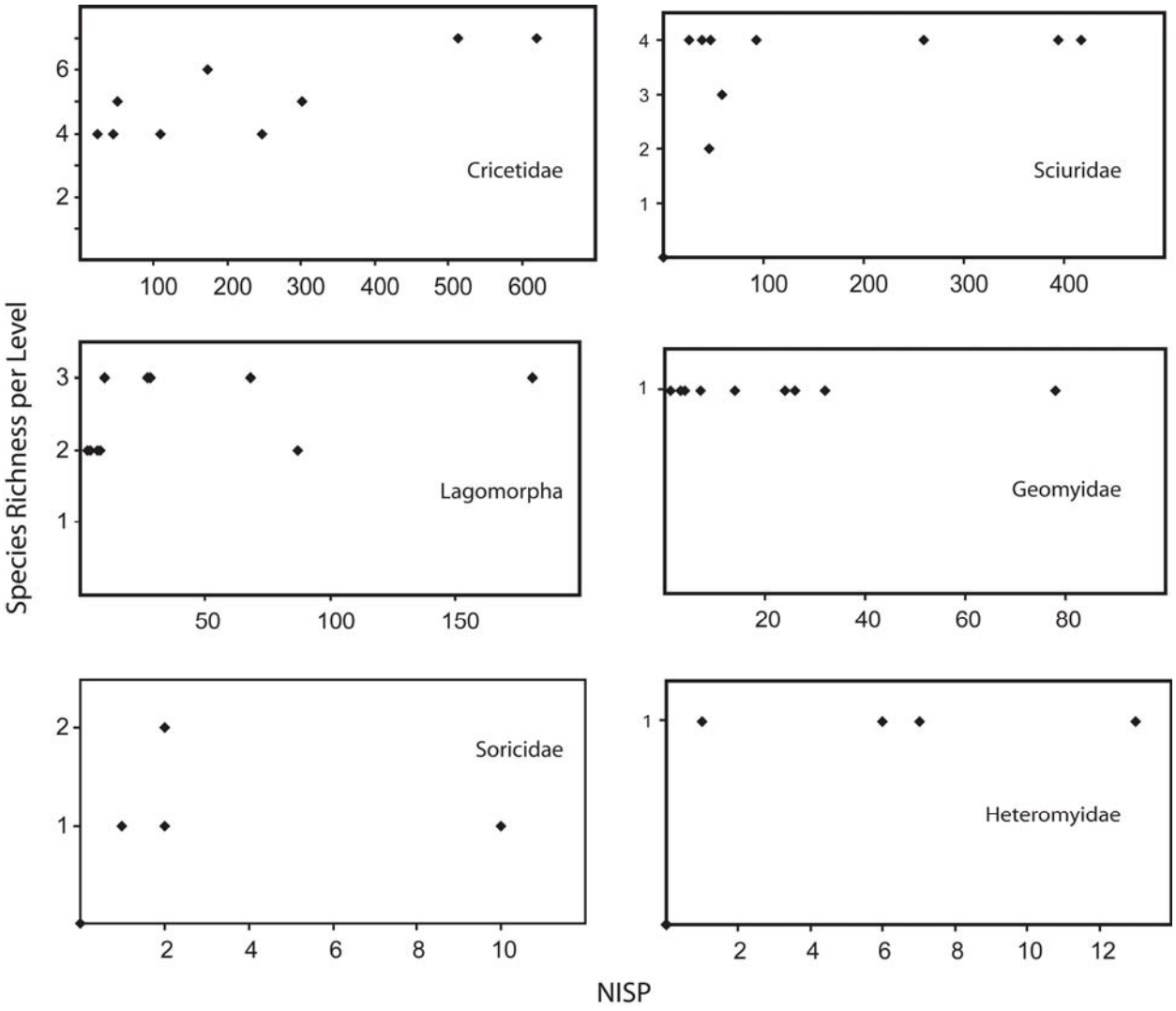


Figure 18. Taxonomic diversity/sample size comparisons for major taxonomic groups. Y-axis is diversity and X-axis is NISP.

The constancy index values for the comparison of taxa and abundances in PSIV and NTC3+NTC4 was high (0.9906) but not significantly different from randomly resampled values

($p = 0.08$). I performed an *a posteriori* test on the abundance data for these levels using Simpson's index of dominance, which has the formula:

$$1-\Sigma p_i^2 \quad (3)$$

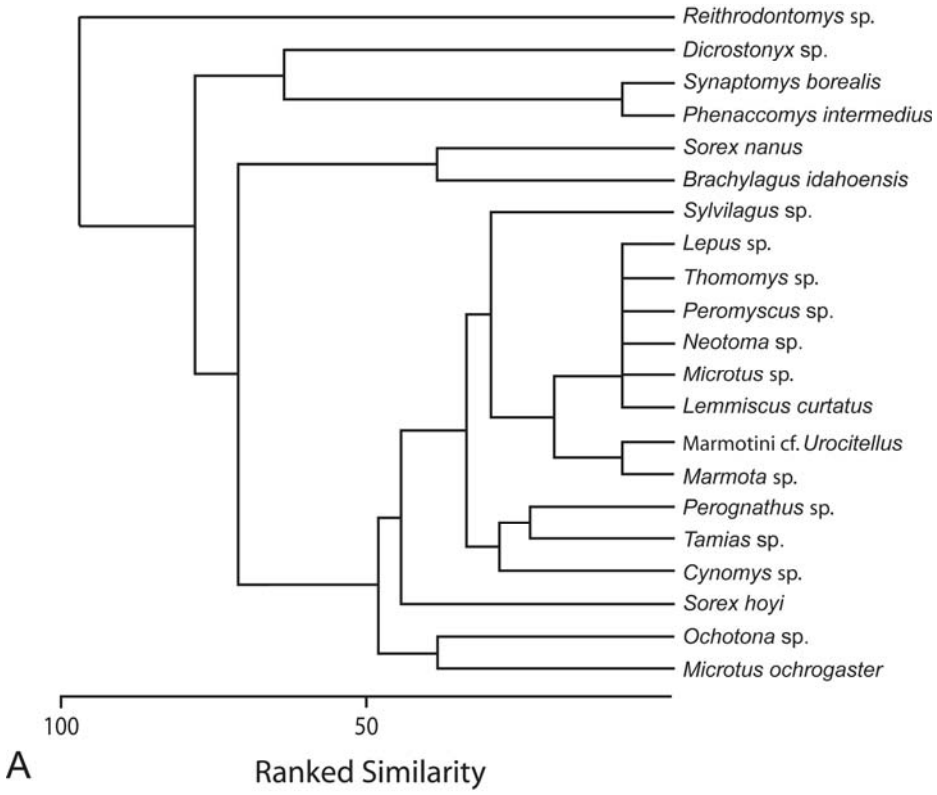
where $p_i = ni/n$ (the proportion of species i). The Simpson's diversity index was significantly different ($p = 0.037$) between the two samples in a bootstrap test.

I found that both ordination techniques grouped faunas from different time intervals together (Fig. 18B, Fig. 6). The clustering algorithm grouped Juniper Cave and HWS together, although both were dissimilar to each other (>50%) (Fig. 18B). The NMDS ordination showed that HWS and Juniper Cave were most dissimilar from all other samples in the first and second dimensions respectively (Fig. 19). Stress values were relatively low (0.06665); evidence that the NMDS result is robust. The extreme values for Juniper Cave and HWS in the NMDS ordination accounts for the cluster JC+HWS separate from other faunas in the UPGMA dendrogram.

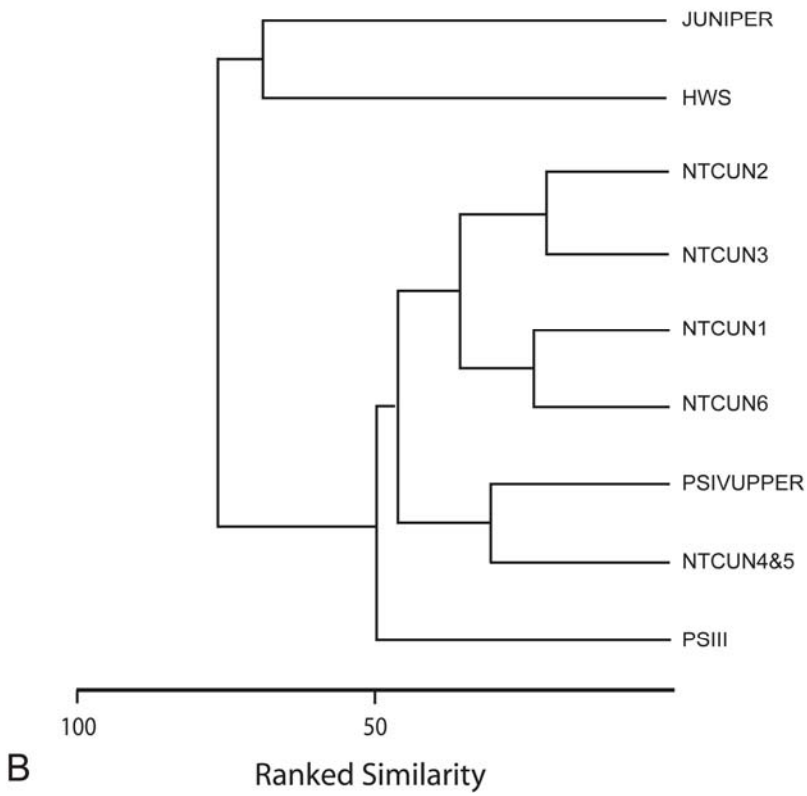
Combined Q and R mode clustering showed that Natural Trap Cave units and Prospects Shelter levels grouped together to the exclusion of Juniper Cave and HWS because both of the latter two localities lack chipmunks (*Tamias*) (Fig. 20). All other samples clustered together with >50% similarity. When the cutoff value was lowered in this cluster, PSIII was excluded due to its lack of *Microtus ochrogaster* and *Sylvilagus*. PSIV and NTC4&5 were excluded from a more narrowly defined cluster due to a lack of *Perognathus*. The remaining two clusters, composed of NTC glacial and interglacial units respectively, were separated based on the lack of cold-adapted taxa (*Dicrostonyx*, *Ochotona*, etc.) in the interglacial cluster (Fig. 20). A cluster of six taxa were found in all samples: woodrat (*Neotoma* sp.), pocket gopher (*Thomomys* sp.), five-triangle voles (*Microtus* sp.), Sagebrush Vole (*Lemmiscus curtatus*), deer mouse (*Peromyscus*

sp.), and hares (*Lepus* sp.). Two more taxa were found in all but one sample: marmot (*Marmota* sp.) and ground squirrel (Marmotini cf. *Urocitellus*).

The Kruskal-Wallis test showed a significant difference ($p = .04991$), but the *post-hoc* Mann-Whitney tests found this was due to the extreme dissimilarity of HWS relative to all other faunas and not through any difference between sites of different ages (Table 10). When the Bonferroni correction is applied these differences become nonsignificant however, so the significant K-W result is probably not important. The ANOSIM supports disregarding the K-W result because the analysis of similarity showed no significant difference between times, with the R statistic not significantly different from zero ($R = 0.03889$, $p = .3795$).


Reithrodontomys sp.
Dicrostonyx sp.
Synaptomys borealis
Phenaccomys intermedius
Sorex nanus
Brachylagus idahoensis
Sylvilagus sp.
Lepus sp.
Thomomys sp.
Peromyscus sp.
Neotoma sp.
Microtus sp.
Lemmiscus curtatus
Marmotini cf. Urocitellus
Marmota sp.
Perognathus sp.
Tamias sp.
Cynomys sp.
Sorex hoyi
Ochotona sp.
Microtus ochrogaster
100
50
Ranked Similarity

A


JUNIPER
HWS
NTCUN2
NTCUN3
NTCUN1
NTCUN6
PSIVUPPER
NTCUN4&5
PSIII
100
50
Ranked Similarity

B

Figure 19. A) Result of UPGMA clustering on ranked BC dissimilarity values for taxa. CC = 0.9549. B) Likewise result for sample clustering. CC = 0.9549.

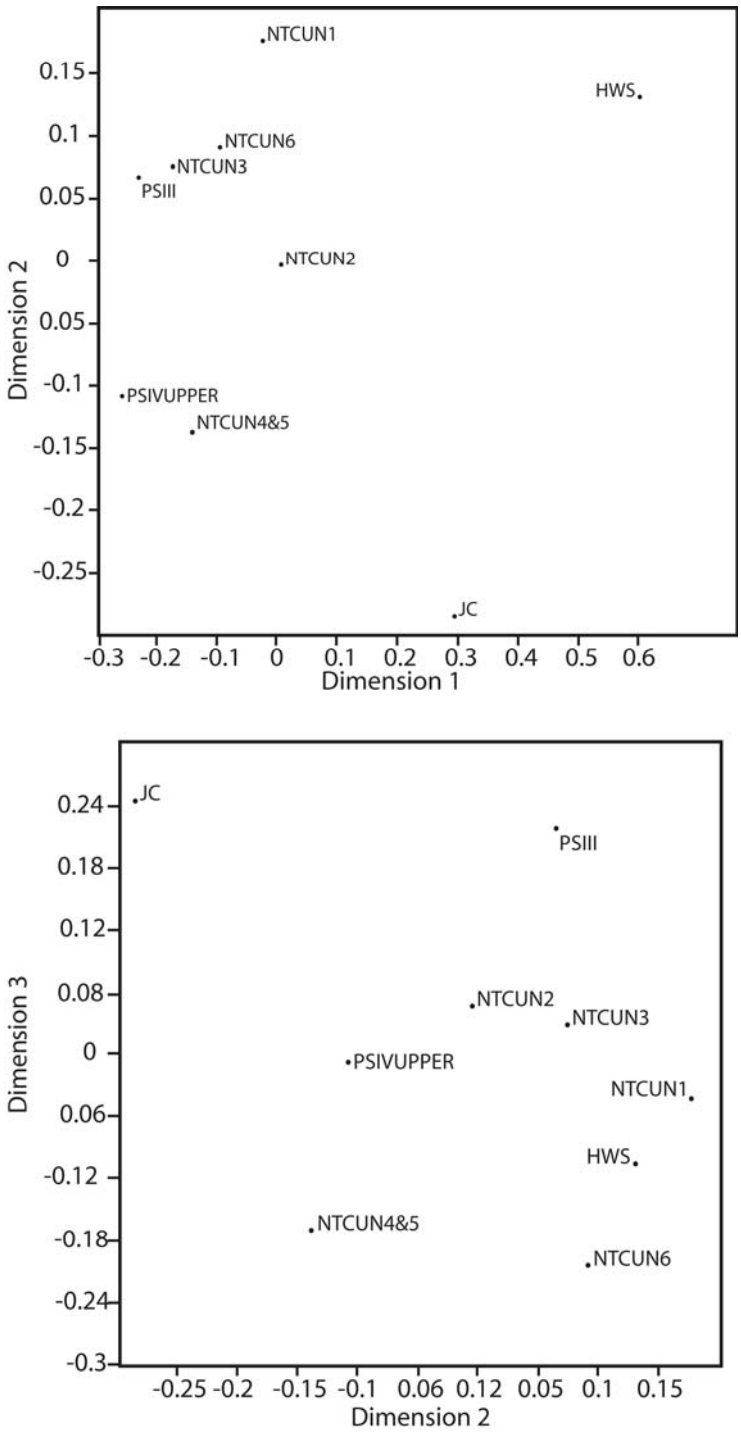


Figure 20. GNMDS scaling of Little Mountain samples in three dimensions. Stress = 0.06665

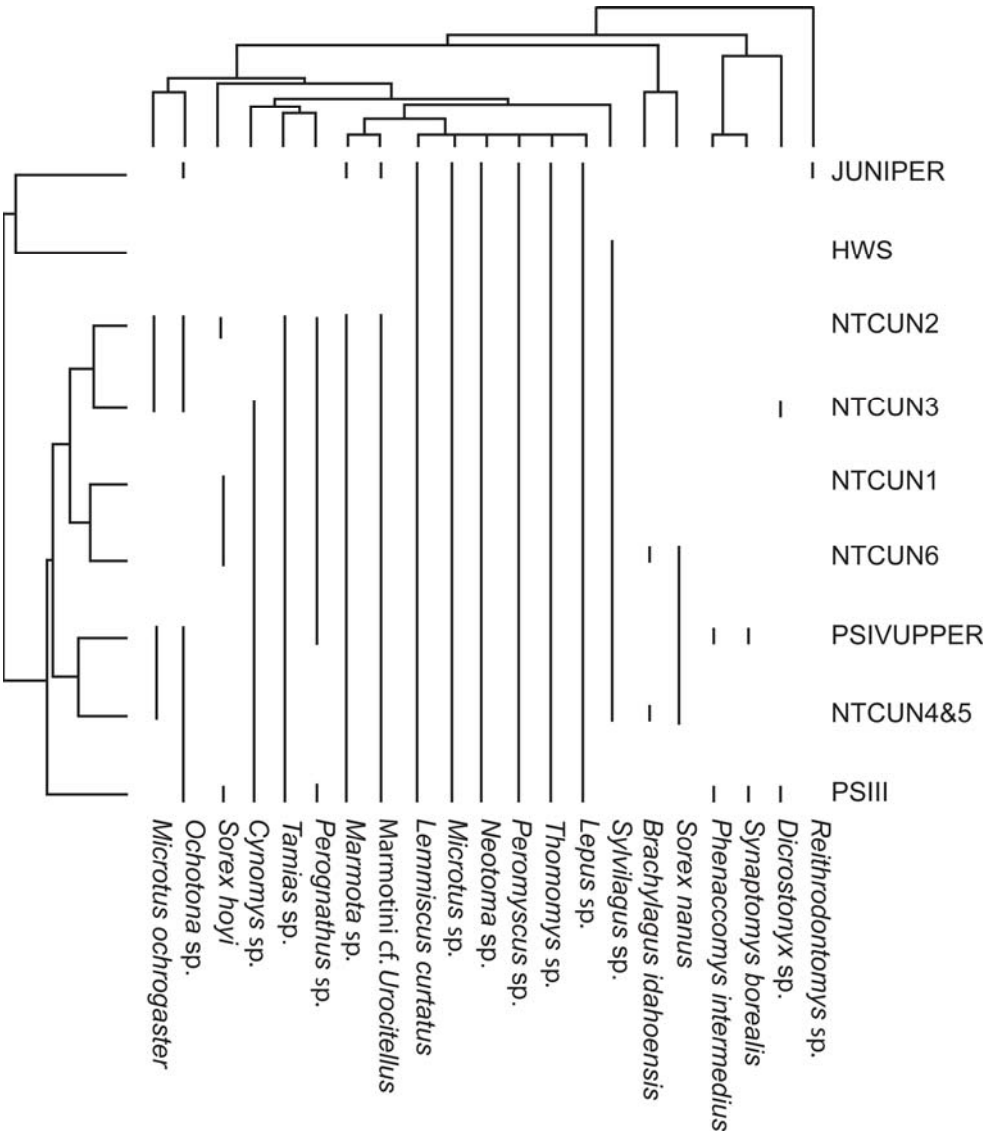


Figure 21. Combined Q and R mode clustering for the Little Mountain samples. The vertical lines represent the range of samples that the taxon is present in and they are not stratigraphic ranges.

Kruskall-Wallis ANOVA	
H	15.51
H_c	15.56
p	0.04991

Mann-Whitney post-hoc pairwise comparisons, Bonferroni corrected\uncorrected									
	PS III	NTC UN2	PSIV	NTC UN3	NTC UN4/5	JC	NTCUN 1	HWS	NTCU N6
PSIII	0	0.4268	0.6272	0.2893	0.7239	0.1451	0.4015	0.05206	0.6911
NTC UN2	1	0	0.8598	0.5962	0.5962	0.03051	0.9648	0.01044	0.7239
PSIV	1	1	0	0.4268	0.8946	0.1333	0.7239	0.04694	0.9648
NTC UN3	1	1	1	0	0.4268	0.1023	0.8598	0.03407	0.4529
NTC UN4/5	1	1	1	1	0	0.07739	0.6272	0.01517	0.9648
JC	1	1	1	1	1	0	0.02728	0.08509	0.1577
NTC UN1	1	1	1	1	1	0.9819	0	0.01342	0.7573
HWS	1	.376	1	1	0.5461	1	0.4831	0	0.0305 1
NTC UN6	1	1	1	1	1	1	1	1	0

Table 11. Results of repeated Kruskal–Wallis nonparametric tests for spatial and temporal differences among temporally grouped Little Mountain samples.

Discussion

Sampling and taphonomy

A comparison between the observed sample values and the rarefaction curve initially indicates that several samples, if increased in size, could have yielded a higher biodiversity (Fig. 16). Furthermore, the largest samples are from the LGM, which also implies that the LIG and interglacial times are undersampled. The cold-adapted taxa observed in the LGM sections of the fauna, taxa that would not be found on Little Mountain otherwise, indicates that a change in biodiversity is a more likely explanation for the greater LGM diversity. The relatively high Little Mountain glacial biodiversity, 25–15 kyr in age, includes *Ochotona*, *Dicrostonyx*, *Phenacomys intermedius*, and *Synaptomys borealis*. A taxonomic base of common taxa is present throughout the sequence that is observed even in the most poorly sampled time intervals (Fig. 20). The presence of these common taxa throughout leads me to conclude that small sample size is not a significant source of bias in my analysis. Various Natural Trap Cave studies also have noted the higher large mammal diversity on Little Mountain during the Wisconsinan relative to the Holocene, so the biodiversity trend seen in small mammals is robust (Martin and Gilbert, 1978; Gilbert and Martin, 1984; Chomko and Gilbert, 1987; Wang and Martin, 1993; Martin and Kadivar, 2003). The same situation, although to a lesser extent, also seems to have been true when comparing the local LIG large mammal fauna and the Wisconsinan large mammal fauna (Chorn et al., 1988; Martin and Kadivar, 2003). Thus, a lower diversity would be expected for any sample not deposited during the glacial time period regardless of sample size.

Hole-in-the-Wall Shelter (HWS) is the one locality where taphonomy appreciably affected biodiversity. The HWS collection was made from a consolidated mound of avian feces and pellets located underneath a roost in the rockshelter (Chomko, 1982). HWS is unique among the

other Little Mountain localities in that only avian predators contributed to the fauna, although other studies have shown that avian predators are implicated in the NTC small mammal fauna. Furthermore, the main faunal difference between HWS and NTC1 is that HWS lacks sciurids, which are diurnal (Fig. 20, Table 9). Nocturnal taxa dominate the HWS fauna, thus owls probably accumulated the HWS fauna. The medium levels of damage observed on specimens from this site also supported this inference. There are two nocturnal small mammal taxa present, albeit in low numbers, in NTC1 and absent in HWS: *Perognathus* and *Sorex hoyi* (Fig. 20, Table 9). The absence of *Perognathus* and *Sorex hoyi* in HWS could be due to the small sample size in HWS, time averaging in NTC1 (present in the early Holocene in NTC, but not the late Holocene), or to a patchy distribution for both of these on Little Mountain. The Olive-backed Pocket Mouse (*Perognathus fasciatus*), which the NTC *Perognathus* are similar to in size, occupies sandy uphill habitats with <40% bare ground (Manning and Jones, 1988). *Sorex hoyi* can be found in a variety of habitats, but Wyoming records tend to be from boreal sphagnum bogs and wooded habitats (Brown, 1967). The patchy distribution of these habitats may be the primary cause of the absence of *Perognathus* and *S. hoyi* in HWS, rather than low sample size. Time averaging in Natural Trap Cave is also a possibility however. NTC1 spans the entire Holocene and some of the latest Pleistocene (13–0 ka), while HWS only records the latest Holocene, so an alternative explanation for the absence of pocket mice and dwarf shrews in HWS is that it could be a true absence. Removal of the sciurids, *Perognathus*, and *S. hoyi* or the HWS sample from the ANOSIM analysis does not change the significance of the result, so the effect of taphonomy and/or time averaging on the biofacies stasis result is minimal.

Taphonomy and community patchiness did affect the taxonomic abundance distribution of Natural Trap Cave and Prospects Shelter, but not the faunal lists. The constancy index and

Bray–Curtis values for PSIV and NTC3+4 are evidence that while the taxonomic list of each site is not significantly different, the abundance distribution is different between these sites. The most likely reason for this is the unique taphonomy of each site due in large part to differences between cave topography and location. Natural Trap Cave is a large pitfall with limited access, only birds, bats, and woodrats can enter and exit NTC, while Prospects Shelter has a horizontal entrance and is relatively small compared to NTC. Therefore, the predator traffic in Prospects Shelter would have been much more heavy than NTC, leading to additional preservation issues like trampling and mixing of sediments through rodent burrowing (Emslie, 1988). Smaller, more delicate rodents like *Tamias* and *Peromyscus* would be more vulnerable to destruction by trampling than the larger rodents, leading to their observed small numbers in PSIV versus NTC3+4. The location of the cave entrance also may have played a role in the different abundance distributions as well as the limited differences in taxa. The entrance to NTC is on a peninsula of the second level of Little Mountain, characterized by low rolling hills. NTC was exposed to north winds and snow accumulation during the time in question, thus low grasses and forbs resistant to snow cover probably always surrounded Natural Trap Cave. Prospects Shelter is located on the valley wall on a south-facing slope. The valley is deep enough to have small, isolated islands of coniferous forests not seen on the level areas of Little Mountain. Natural Trap Cave is situated such that the valley and sagebrush steppe could have been sampled, while Prospects Shelter is likely a better representation of the valley fauna. Northern Bog Lemming (*Synaptomys borealis*) and Western Heather Vole (*Phenacomys intermedius*), two rare taxa unique to Prospects Shelter (Table 9), are both found in modern habitats notable for moisture (sphagnum bogs, wet spruce forest, on arctic tundra near water) (Mead et al., 1992; Fitzgerald et al., 1994). Spruce (*Picea engelmanni*) and Lodgepole Pine (*Pinus contorta*) were found in

Natural Trap Cave valley woodrat middens dated >30 kyr BP, so the valley surrounding Prospects Shelter was probably a moist coniferous forest habitat during the Pleistocene (Wells, 1987). Thus, I conclude that the unique conditions surrounding Prospects Shelter and NTC, as well as unique cave topography, is evidence that the abundance distributions of each Little Mountain sample are most likely unique and non-comparable, although this does not seem to have affected taxonomic representation to a great extent.

Eagle Shelter also showed evidence of a microhabitat that existed in the Natural Trap Cave canyon. Southern Red-backed Vole (*Myodes gapperi*) is present throughout much of the Eagle Shelter sequence (Chomko and Gilbert, 1987). The preferred habitat of *M. gapperi* is mesic forest with abundant litter (Merritt, 1981). Thus, Eagle Shelter extends the Prospects Shelter evidence for a localized forest habitat in the Natural Trap Cave canyon into the Holocene.

Another taphonomic consideration that is especially important for a study purporting to detail large-scale community patterns, is how well the Holocene Little Mountain biofacies represents the living community. The fact that Little Mountain has not been extensively sampled for modern small mammals and the existence of several different habitats on the mountain limits the usefulness of my comparison, but they should serve as a basic metric. Comparison was based on limited trapping carried out during excavation and from published records. Chomko and Gilbert (1987) listed modern taxa collected or observed during Natural Trap Cave excavations (June–August) (Table 11). Small mammal collections were limited to two transects of snap traps in the valley adjacent to Eagle Shelter (Chomko, pers. comm.). I also used Long's (1965) database of small mammal records for Bighorn, Washakie, and Hot Springs counties. A taxon was considered likely if the taxon had been trapped at elevations both above and below NTC. The combined NTC1 and HWS faunas are similar to the expected modern local

community (62% shared taxa) with some exceptions (Table 11). Three taxa present in NTC1 have no modern records in Bighorn County: Richardson's/Wyoming ground squirrel (*Urocitellus richardsonii*/*elegans*), prairie dog (*Cynomys* sp.), and Sagebrush Vole (*Lemmiscus curtatus*). White-tailed Prairie Dog (*Cynomys leucurus*) is recorded from the Bighorn Basin with the nearest occurrence being the foothills of the Bighorn Mountains around Shell, WY (Long, 1965). *Urocitellus* has no modern records from the Bighorn Basin however; the genus has a distribution in basins S and N of the Bighorn Basin (Long, 1965). *U. richardsonii*/*elegans*' distribution has shifted since the Pleistocene, with the centroid moving from the western Great Plains to the intermontane basins (Neuner, 1975). All of these taxa are found in habitats (sagebrush, grasslands) that are only present in localized areas in the Bighorn Basin, primarily the foothills of the Bighorn Mountain (Knight, 1994). Thus, the NTC records may represent wetter, pre-altithermal Holocene distributions, or a lack of modern sampling in the foothills region. In summary, the Holocene record on Little Mountain is generally similar to the expected modern fauna, and I predict that the similarity may increase with more sampling effort of the modern Little Mountain fauna.

Biofacies stasis

The Little Mountain biofacies remained statistically constant in membership for at least 100 ka with variability within time intervals (spatial variability) not significantly smaller than variation between times (temporal variability). A biofacies change would have been recorded as temporal variability greatly exceeding spatial variability, essentially splitting the fauna into three blocks: pre-glacial, glacial, and post-glacial. The fauna was instead characterized by a constant membership that was added to by invading arctic and montane taxa during the glacial advance

that were then extirpated contemporaneous to the deglaciation. The stasis observed on Little Mountain can best be explained by a combination of the climate variability hypothesis (Stevens,

Taxa	Chomko and Gilbert, 1987	Expected from Long, 1965	NTC1	HWS
Sorex hoyi	0	0	1	0
Sylvilagus sp.	1	1	1	1
Lepus sp.	0	1	1	1
Perognathus sp.	0	1	1	0
Thomomys sp.	1	1	1	1
Marmotini cf. *Urocitellus*	0	0	1	0
Cynomys leucurus	0	0	1	0
Marmota flaviventris	0	0	1	0
Tamias minimus	1	1	1	0
Peromyscus maniculatus	1	1	1	1
Neotoma cinerea	1	1	1	1
Microtus montanus/longicaudus	0	1	1	1
Lemmiscus curtatus	0	0	1	1

Table 12. Presence-absence data for taxa trapped or observed by Chomko and Gilbert (1987) during summer excavation, expected taxa from Long (1965), and the taxa found in all Little Mountain Holocene samples.

1989) and individual species biome specialization, with some contribution from geographic barriers. While there is no evidence to contradict an Eltonian interpretation of the local community as a super-organism, the distributions and adaptations of individual taxa are sufficient to explain the observed pattern. The tolerances of a large proportion of the Little Mountain taxa are so broad, that they could interact in a Gleasonian model and still remain associated locally.

Species distributions are positively correlated with latitude; species closer to the poles have larger latitudinal ranges than those in the tropics (Rapaport effect). Stevens (1989)

proposed the climate variability hypothesis to explain the large latitudinal range of high-latitude species. Briefly stated, Steven's (1989) hypothesis is that organisms at higher latitudes experience environmental extremes of temperatures due to seasonality. Therefore, physiological tolerances are selected for in high latitude species, which often results in a taxon that can exist in a wide variety of climatic conditions (Stevens, 1989). This argument has elements of circularity at this point, it is unknown if the environment is the cause or the effect, but some form of species sorting for environmental tolerances does seem to take place in the high latitudes regardless. Hernández Fernández and Vrba (2005) found that high latitude species in Africa also tend to be generalists, thus providing further evidence for the trend. Kaufman (1995) documented this in North American mammals, only a few generalized "bauplans" exist in the polar regions.

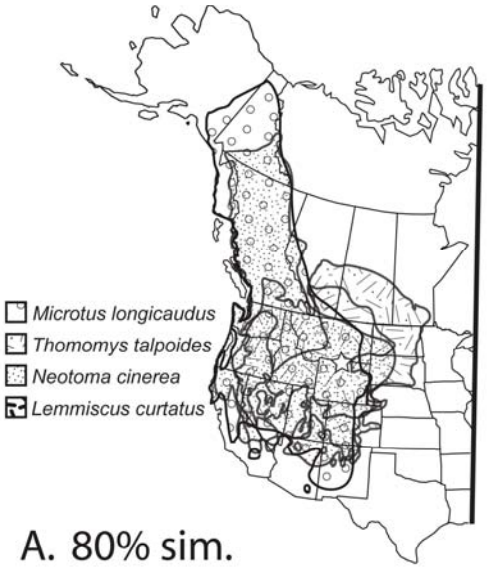
The environment on Little Mountain is an example of seasonal extremes, a situation in which generalists should be well suited according to the climate variability hypothesis. Little Mountain is located in the mid-temperate latitudes (44.58° N), and as a result is exposed to seasonal changes in temperature and moisture. Annual temperatures at Lovell, WY, ~20 km west of Little Mountain, range from a monthly mean of 21.38°C in July to –8.38°C in January (Clim20, 2004). Extreme values often determine the ability of a species to exist in a given area however. The complete range of temperatures recorded in Lovell is –39–41°C (Clim20, 2004). The Bighorn Basin is relatively arid due to the rain shadow effect, so mean annual precipitation in Bighorn Mountain foothills is low, 30.48 cm (Martner, 1986). Thus, modern species of the foothills are adapted to an arid environment featuring extreme seasonal values in temperature. Little Mountain was probably not as arid during the Pleistocene, but the local climate undoubtedly featured extreme seasonal temperatures. In a preliminary study of the pollen record from Natural Trap Cave, Johnson and Fredlund (1982) found that the area's glacial floral

community was similar to the dry Mammoth steppe described from the Pleistocene of Alaska (Guthrie, 2001). The arid, cold conditions suggested by the Natural Trap Cave pollen are reinforced by soil evidence from the Bighorn Basin. Nissen and Mears (1990) found permafrost features on the floor of the Bighorn Basin, indicating that tundra-like conditions occurred even at low elevations in Wyoming during the Pleistocene. Thus, the local Pleistocene climate was as favorable, if not more so, to generalists than the modern climate.

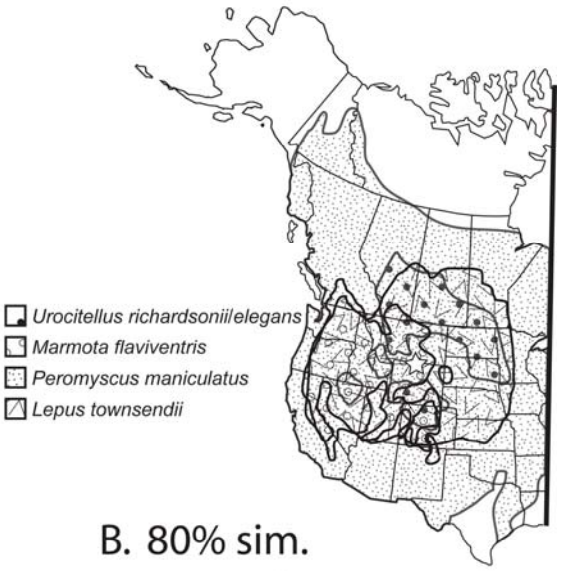
Little Mountain fossil taxa reflect the abiotic forces of the area in their distributions and habitat specializations. Taxa that occur in most samples have distributions in which the Bighorn Basin is well within the range boundaries (Fig. 21A, B, C) and are either biome generalists or steppe/grassland specialists (Fig. 21A, B, C; Table 4). Thus, taxa found in every sample [Sagebrush Vole (*Lemmiscus curtatus*), Bushy-tailed Woodrat (*Neotoma cinerea*), Long-tailed Vole (*Microtus longicaudus*), Northern Pocket Gopher (*Thomomys talpoides*)] have modern distributions that include the Bighorn Basin near the center of the distribution and are either grassland/steppe specialists or habitat generalists (Fig. 21A, Table 4). The bias towards open-adapted taxa in the Little Mountain biofacies is due to local terrain topography. In the foothills on the western side of the Bighorn Mountains, lack of soil moisture limits trees to slopes where collected snow melts and replenishes deep soil moisture annually (Knight, 1994), so an open vegetation biome has always predominated on the plateau areas of Little Mountain.

Taxa limited to the glacial section of the Little Mountain fauna have modern distributions that are centered in the Great Plains, the boreal taiga, arctic tundra, or strictly montane habitats (e.g. alpine meadows and tundra) (Hall, 1981) (Fig. 20D & E). The climate change experienced during the last glacial period pushed these types of biomes south in front of the ice sheets and down elevation in the Bighorn Mountains. Montane taxa, such as pika (*Ochotona*) and marmot

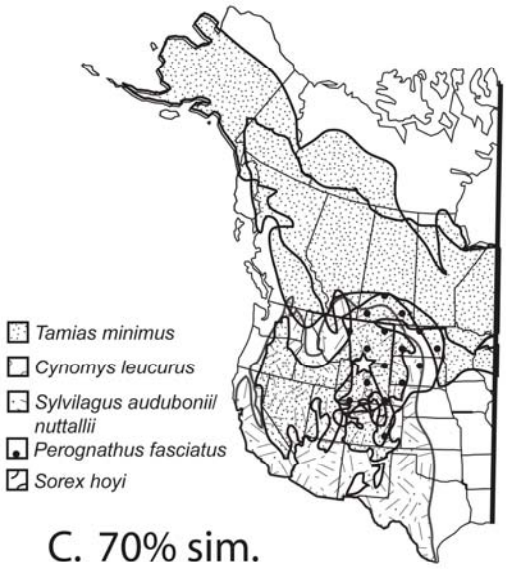
(*Marmota*) do not occur on Little Mountain today, instead they are restricted to higher elevations. Grayson (1987) noted this pattern in Great Basin small mammals, taxa currently restricted to isolated mountain chains in the Great Basin had Pleistocene records in the intervening low areas.



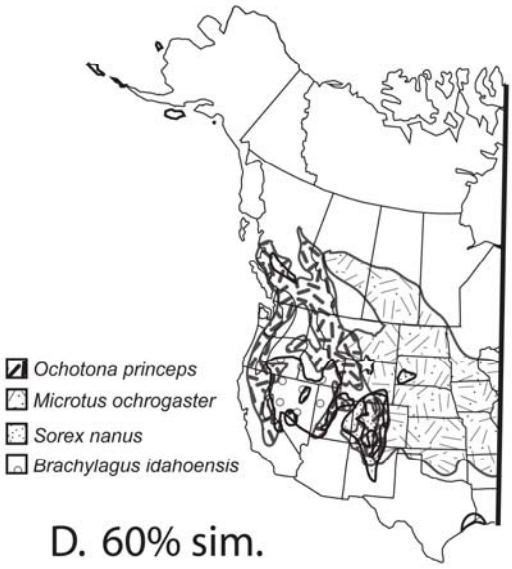
A. 80% sim.



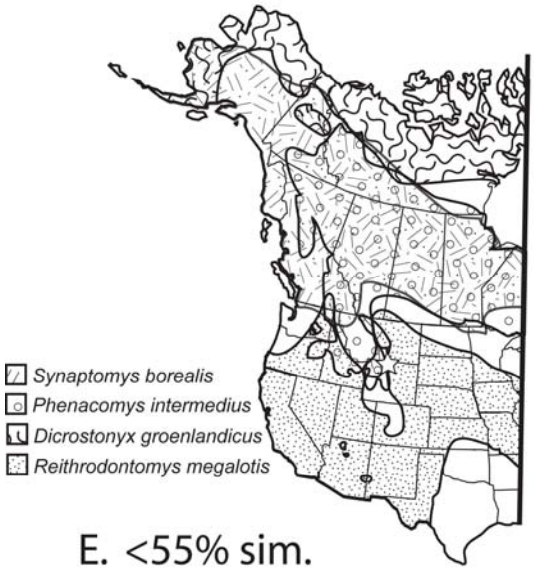
B. 80% sim.



C. 70% sim.



D. 60% sim.



E. <55% sim.

Figure 22. Modern Little Mountain taxa distributions, data taken from Hoffmann and Owen (1980) and Hall (1981). Taxon distributions grouped by extent of co-occurrence: A) 100% of samples, B) 80% of samples, C) 70% of samples, D) 55% of samples, E) <55% of samples.

The Little Mountain biofacies stasis, caused in large part by the cosmopolitan member species, has ramifications for how the Quaternary glacial cycles have affected mammalian evolution. Quaternary glacial cycles, which are in turn orbitally forced, have been argued to be prime candidates as drivers of evolution because of the potential for isolation. The importance of reproductive isolation for speciation was recognized as a key element of speciation in the Modern Synthesis. The potential for isolation as a result of glacial cycles is present, whether through changing climate causing the breakup of habitats or through sea level change. Mammalian speciation rates are elevated during the Quaternary, but the process is spread over several glacial cycles and within a single glacial cycle (Lister, 2004). In fact, the mammals that make up many Pleistocene faunal provinces, such as the 'mammoth-wooly rhinoceros faunal complex' of northern Eurasia were composed of species with first appearances 800,000 years ago (Kahlke, 1999). 37% of the North American mammal fauna (including Chiroptera) is older than Rancholabrean (0.15ma.) in age, with the first modern species appearing during the Blancan (>~1.9 ma.) (Kurtén and Anderson, 1980). Lister (2004) argued that the Quaternary mammal species, descended from lineages that had survived earlier extinction events were generalists and therefore resistant to speciation as a result of climate change. Lister (2004) also noted that mammalian species last a million years on average, so the evolutionary dynamics of the clade may preclude cladogenesis on glacial cycle time scales. The overall pattern in the mammal fossil record is that single glacial cycles promote subspecific variation, but not speciation.

Taxon	Biomes inhabited	Reference
Sorex hoyi	(1) localized near mountain streams and successional cool conifer forest	Long, 1974
Sorex nanus	(3) grassland, cool conifer forest, tundra	Hoffmann and Owen, 1980
Ochotona sp. (*O. princeps*)	(1) tundra	Smith and Weston, 1990
Brachylagus idahoensis	(1) steppe	Green and Flinders, 1980
Sylvilagus sp. (*S. audubonii, nuttallii*)	(5) open conifer woodland, xerophytic woods/scrub, grassland, steppe, desert	Chapman, 1975; Chapman and Willner, 1978
Lepus sp. (*L. townsendii*)	(4) grassland, steppe, tundra, open conifer woodland	Kim, 1987
Perognathus sp.	grassland	Manning and Jones, 1988
Thomomys sp. (*T. talpoides*)	(3) tundra, open conifer woodland, grassland, steppe	Verts and Carraway, 1999
Marmotini cf. *Urocitellus* (*U. richardsonii/elegans*)	(3) steppe, grassland, tundra	Zegers, 1984; Michener and Koeppl, 1985
Cynomys sp**.**	(2) grassland, steppe	Nadler et al., 1971
Marmota sp. (*M. flaviventris*)	(2) grassland, tundra	Frase and Hoffmann, 1980
Tamias sp. (*T. minimus*)	(5) tundra, cool conifer forest, open conifer woodland, temperate deciduous forest, steppe	Verts and Carraway, 2001
Phenacomys intermedius	(1) cool conifer forest	McAllister and Hoffmann, 1988
Synaptomys borealis	(2) tundra, cool conifer forest	Banfield, 1974
Peromyscus sp. (*P. maniculatus*)	(8) Tundra, cool conifer forest, open conifer woodland, temperate deciduous forest, xerophytic woods/scrub, grassland, steppe, desert	King, 1968
Reithrodontomys sp**.** ***(****R. megalotis****)***	(2) grassland, open conifer woodland	Webster and Jones, 1982
Neotoma sp. (*N. cinerea*)	(4) cool conifer forest, open conifer woodland, grassland, steppe	Smith, 1997
Microtus sp. (*M. longicaudus*)	(4) tundra, steppe, cool conifer forest, open conifer woodland	Smolen and Keller, 1987
Microtus ochrogaster	(1) grassland	Stalling, 1990
Lemmiscus curtatus	(2) grassland, steppe	Carroll and Genoways, 1980
Dicrostonyx sp.	(1) tundra	Banfield, 1974

Table 13. Number and type of biomes inhabited by Natural Trap Cave taxa. Biome classification follows Thompson and Anderson (2000).

The disjunct between climate change and speciation in the Quaternary is juxtaposed against the pattern in earlier biotas, in which last appearances and first appearances are often linked to environmental change. Some of the faunal turnovers in the Neogene mammal fauna of northern Pakistan and the Paleogene mammal fauna of the Bighorn Basin, WY are correlated with global climate events (Barry et al., 1995), while others may be correlated with undocumented regional disturbances. Vrba (1985) found a similar pattern of faunal turnover in Neogene African mammals, which she termed turnover pulses. Vrba (1985, 1992) posed a model explaining the turnover pulses as faunal change linked to environmental disturbance. Turnover pulses also have been found in North America. Martin and Fairbanks (1999) found pulses of elevated faunal turnover in the small mammal faunas of the Meade Basin of southwestern Kansas, which spans 4.2 ma. The timing of extinction pulses was not the focus of Martin and Fairbanks (1999), but the largest extinction pulse (11 taxa) occurred at 2.5–2.0 ma, roughly contemporaneous with the intensification of global cooling that has characterized the Quaternary (see review in Vrba et al., 1989). The coordinated stasis pattern of Brett and Baird (1995) is related to the turnover pulse because the faunal turnover in their benthic marine faunas was related to regional disturbances (increases in clastic input, anoxic events, etc.). The destruction of local ecosystems through environmental disturbance is causally linked to evolution (Miller 2002, 2004). There are exceptions to the pattern however, Prothero and Heaton (1996) documented faunal stability in the Great Plains during the Eocene-Oligocene 'climatic crash.' This caused Vrba (1987) to revisit the turnover pulse hypothesis by looking at the tempo of speciation in generalists (relatively slow) and specialists (relatively fast). The generalist/specialist distinction works well

for Little Mountain; the biofacies stasis taxa are all generalists, or at least open habitat specialists. If Little Mountain is a faithful representation of the regional ecosystem as a whole, then the Quaternary glacial cycles may not be a severe enough disturbance to cause regional ecosystem replacement, and subsequent speciation/extinction, at least in some biomes.

Other fossil and modern evidence suggests many regional ecosystems in the North American Cordillera may have remained static during the Quaternary glacial cycles. Porcupine Cave is another temperate latitude Pleistocene locality in an intermontane basin (South Park, CO). South Park, like Little Mountain, is dominated by a grass steppe and is arid with cool summers and cold winters. The Pit locality, from a stratified room within Porcupine Cave, has a small mammal fauna that span three interglacial and two glacial periods from the mid-Pleistocene (Barnosky, 2005). Barnosky (2005) noted that the small mammal record was not static, but the fauna remained similar through glacial cycles. Furthermore, immigrations and extinctions were clustered in the middle interglacial, which could possibly be interpreted as a turnover pulse (Barnosky, 2005). McGill et al. (2005) analyzed the Porcupine Cave biofacies record for statistical significance and found significant stasis on the scale of 100 kyr. Molecular phylogeography of western North American species also suggests the Quaternary glacial cycles caused little real speciation. Modern phylogeography of pocket mice (*Perognathus* and *Chaetodipus*) and grasshopper mice (*Onychomys*) suggests that much of the speciation in these groups occurred before the Plio-Pleistocene glacial cycles intensified (Riddle et al., 1993; Riddle, 1995). Divergence in these groups is best interpreted as a result of uplift of the western North American cordillera during the later Tertiary–early Quaternary (Riddle et al., 1993; Riddle, 1995). The phylogeography of a wide range of terrestrial vertebrates of the arid southwest has also been interpreted as a result of pre-Quaternary processes (reviewed in Jaeger et

al., 2005). The phylogeographic evidence for little speciation as a result of Quaternary glacial cycles in western North America implies that regional ecosystems have been stable.

History does play a role however, such that some areas did experience local change. Records of change show that even when local faunal change does occur congeners replace existing members resulting in a similarly structured fauna. Heaton (1990) noted this trend in Crystal Ball Cave, UT, a locality in a low-elevation valley in the Great Basin which was ~2 km from the shore of Lake Bonneville during the Pleistocene. Much of the Pleistocene Crystal Ball Cave fauna is replaced in the modern fauna by arid-adapted congeners (Heaton, 1990)—White-tailed Jackrabbit (*Lepus californicus*) replaced Black-tailed Jackrabbit (*L. townsendii*), Desert Woodrat (*Neotoma lepida*) replaced Bushy-tailed Woodrat (*N. cinerea*), Desert Cottontail (*Sylvilagus audubonii*) replaced Nuttall's Cottontail (*Sylvilagus nuttallii*). In each of these cases, both taxa were present in the Pleistocene record and one was extirpated in the modern fauna. The guild structure therefore remained the same, as there is minor morphological difference between the congeners listed in the Crystal Ball Cave fauna. Thus, even when there is faunal change in western North America, the regional community was reorganized but not replaced.

The role of geographic barriers in forming biogeographic provinces in western North America may have contributed to the observed biofacies stasis on Little Mountain. Roy (2001) documented the effect of nearshore biogeographic boundaries on biofacies stasis in Pleistocene mollusks of California. Roy (2001) noted that mollusk assemblages located near the center of provinces, as defined by geographic boundaries that have not changed over time, changed less than faunas located near the boundaries. More extreme climate disturbances, beyond that of a glacial advance, would be needed to change communities in the center of a biogeographic province (Roy, 2001). Riddle (1998) found evidence for the influence of biogeographic

provinces on range shifting in Pleistocene North American rodents. The distribution of rodent taxa was constrained by the boundaries of geomorphologic provinces, boundaries that Riddle (1998) argued approximated the location of major barriers to dispersion. Lyons (2005) found that the Rocky Mountain region is an exception to the pattern found by Riddle (1998). Lyons (2005) found community stability was significant in the Great Plains, the southeastern United States, and the southwestern United States during the Preglacial–Glacial and Glacial–Holocene transitions, but not in the Rocky Mountains. Lyons (2005) argued from this evidence that the biogeographic province argument of Roy (2001) did not apply to western North America. Riddle (1998) concentrated on rodents however, whereas Lyons (2003, 2005) analyzed the complete FAUNMAP data set. The inclusion of the more mobile large mammals by Lyons (2003, 2005) may have caused the significant community change result in the Rocky Mountain region. Future objectives for the Little Mountain biofacies include enlarging the spatial scale to include the regional ecosystem, followed by retesting the regional data for stasis.

I argue from the Little Mountain record and the others cited that Quaternary glacial cycles represent an intermediate disturbance, below what would be required to cause regional ecosystem reorganization/replacement and cladogenesis/extinction. The pattern that emerges from the Little Mountain data is a few abandonments and invasions while the basic membership otherwise remains constant. I am not suggesting that species that remained on Little Mountain are made up of a lineage of descendent populations, but rather the populations of species that remained were able to continually recruit new members of the species after high-frequency local disturbances because the surrounding habitat remained suitable for them. Long (1965) included the Little Mountain area as part of the Transitional Life Zone, which features taxa from higher and lower elevations. Sources for replenishment of Little Mountain after local disturbances have

therefore come from the boreal Bighorn Mountains and from the Bighorn Basin. Long (1965) also commented that the youthful nature of the Bighorn River in Wyoming (down cutting, narrow valleys) makes the river a conduit of immigration rather than a barrier to dispersal. The riparian environment surrounding the Bighorn River was therefore a likely low-elevation source for the replenishment of Little Mountain populations. Incidentally, this also may help explain the rarity and lack of diversity of arid-adapted taxa on Little Mountain that are common in the Bighorn Basin, such as heteromyids. The persistence of more boreal taxa, such as marmots, in the Little Mountain sequence, shows the contribution of higher elevations that have also been sources for the Little Mountain area in the past. The observed reaction of Little Mountain taxa is similar to what has been recorded by others; the first reaction of the component organisms of an ecosystem to an environmental disturbance is to track the suitable habitat (Vrba, 1992; Eldredge, 2003). The local environment remained suitable for most taxa present on Little Mountain, so the net local result was stasis. Minor abandonments and invasions occurred however, such as local extirpation of the Pygmy Rabbit (*Brachylagus idahoensis*) during the glacial climate intensification and the subsequent invasion of Collared Lemming (*Dicrostonyx groenlandicus*), as these species tracked suitable habitat accessible to them. This level of change accords with Level 3 of Eldredge's (2003) 'sloshing bucket' model of evolution. Eldredge (2003) organized the levels of environmental disturbance according to the proposed effect of those disturbances on species. A Level 3 disturbance is slow and gradual allowing species that are affected to shift populations to favorable habitats, while the net local effect is stability. It should be emphasized that history undoubtedly matters as to whether local ecosystems were reorganized/replaced during the last glacial cycle. For example, much of the central Great Plains during the Wisconsinan glacial age was open taiga woodland, a unique regional ecosystem not replicated

today (Wells and Stewart, 1987). The increased number of invasions and abandonments in the Great Plains relative to Little Mountain may be due to the mountain filter, both to dispersal and climate, which exists for the Bighorn Basin.

Conclusions

The Little Mountain biofacies records local biofacies evolution over the course of the last glacial cycle. Natural Trap Cave and nearby rockshelter samples have small mammal faunas that indicate an open habitat with islands of coniferous forests, varying in size through time, present on valley slopes. There is a core group of taxa that occurred throughout the sequence with some minor invasions and extirpations. The modern distribution of the Little Mountain taxa that persisted throughout the record, and by inference their physiological and habitat tolerances, explains the biofacies stasis observed. The taxa that remain associated through time on Little Mountain are biomic generalists, or at least open biome specialists, and have wide physiological tolerances as indicated by the large latitudinal distributional range. This data can neither refute nor accept the Eltonian or Gleasonian community models. A large proportion of Little Mountain taxa have tolerances so broad that the stasis result does not disprove or prove the Eltonian model. The biofacies stasis observed on Little Mountain over the course of a glacial cycle reinforces other evidence that suggests climate change associated with glacial cycles is not severe enough to cause the widespread destruction of regional ecosystems. Instead the pattern that emerges in the North American Cordillera is a mixture of regional ecosystem stasis or reorganization, although more extreme change occurred in other regions.

CHAPTER 5

The geographic scale of faunal change during the last glacial cycle in the Central Rocky Mountains

The geographic and chronologic scale of paleocommunity studies affects the result of coordinated stasis studies. Bennington and Bambach (1996) and Bennington (2003) investigated how the structure of living communities as well as taphonomy affects the results of stasis studies. Individuals in communities are not spread homogenously over the landscape. Winnowing, storm event, etc. can concentrate death assemblages, so a fossil sample that does not cover a wide area could miss potential community members due to taphonomy (Bennington and Bambach, 1996; Bennington, 2003). For this reason, Brett et al. (1996) recommended that formations be bulk sampled in multiple outcrops to construct a robust dataset and that an event that could cause faunal turnover be included during sampling. Therefore, studies of stasis should include faunal provinces as the main test unit.

Roy (2001) found that increasing the geographic scale of stasis studies revealed a biogeographic cause for stasis. Using Pleistocene near-shore shell beds, Roy (2001) noted that the pattern of faunal stasis/change differed depending on where sampling occurred relative to the edges of the faunal province. Samples closer to the boundaries of the province showed more faunal turnover through time than those sampled closer to the province center (Roy, 2001). Roy (2001) found that more extreme climate change than that observed during the Quaternary glacial cycles would be necessary to change the fauna in province centers. Therefore stasis may be a phenomenon of the faunal province.

Geographic scale of studies has been shown to be important in Quaternary terrestrial faunas. The association of mammal taxa in nonanalogous assemblages that do not occur together

now implies the independent movement of species relative to each other during the last deglaciation. Graham and Grimm (1990) noted the frequency of nonanalogous local mammal faunal assemblages during the late Pleistocene in North America and argued that Quaternary communities of terrestrial animals therefore changed constantly in response to climate change. Graham et al. (1996) expanded the geographic scale to include the contiguous United States and found a similar result. Communities broke up during the last deglaciation and the distributions of the constituent species shifted independently of one another, especially in the Great Plains. Coordinated movement of large "suites" of mammal species was observed on regional scales however (Graham et al., 1996). Some faunal provinces, including their central Rocky Mountain cluster, also maintained much of their shape and character through the deglaciation. Lyons (2005) also noted blocks of regional stasis in mammal faunas during the end of the Wisconsinan glaciation, although never in the Bighorn Mountains. Riddle (1998) found strong evidence for stasis at the scale of geographic provinces in rodent distributions of the last 100 kyr. Therefore, there is evidence that faunal stasis occurred in mammal communities during the last glacial cycle within some regions, but not in many local assemblages or in the continental mammal fauna.

The small mammal fauna in Natural Trap Cave retained a core membership during the last glacial cycle. This is an unexpected result because Natural Trap Cave is a nonanalogous assemblage and located in an area where regional stasis is unexpected according to Lyons (2005). Natural Trap Cave contains a nonanalogous small mammal assemblage, with mammals such as the arctic Collared Lemming (*Dicrostonyx groenlandicus*) and Arctic Hare (*Lepus arcticus*) occurring with a small mammal fauna very similar to the modern local community. Natural Trap Cave biofacies stasis implies that the regional ecosystem was not destroyed at the end of the Last Glacial Maximum (~18 kyr BP), but instead reorganized as the arctic members of

the fauna were locally extirpated. Cosmopolitan habitat requirements of the small mammal members of the regional ecosystem and geography probably played a dual role in causing the local biofacies stasis observed in Natural Trap Cave. Much of the cave small mammal fauna is composed of species with widespread modern distributions that would therefore require extreme climate change to extirpate locally. Roy's (2001) biogeographic hypothesis may therefore play a role. Major elevation barriers surrounding Natural Trap Cave also likely influenced local faunal stability.

My objective is to test for a possible biogeographic cause for the biofacies stasis observed on Little Mountain during the last glacial cycle. To test for the effect of biogeography, I map the faunal province that Natural Trap Cave is located in through the last glacial cycle. If Roy's (2001) hypothesis is correct, Natural Trap Cave should be located near the center of the Montanian mammal biogeographic province of which it is a part. The importance of geographic barriers for maintaining faunal stasis also is assessed.

Materials and Methods

I use the FAUNMAP database to identify regional ecosystems in the central Rocky Mountains (Graham et al., 1996). The FAUNMAP record does not have a representative sample of LIG faunas, so the record is supplemented by the LIG faunas reviewed in Pinsof (1996). An additional ID Holocene locality (Rattlesnake Cave) not found in the FAUNMAP database is also included here (Steadman et al., 1996). Localities are drawn from nine states (ID, MT, NE, ND, OR, SD, UT, WA, WY) and three Canadian provinces (AB, BC, SK) and then binned into four time periods: 10–0 ka, 35–10 ka, 100–35 ka, and >100 ka. These time periods allow for the most precise use of the FAUNMAP faunal aging classification and the chronological system in Natural Trap Cave. To be comparable with my study of the small mammal fauna of NTC, only small mammals (Soricidae, Talpidae, Lagomorpha, Rodentia) are included in this analysis.

Taphonomic bias is a problem when comparing different sites, so the effect of taphonomy is minimized by grouping faunas with less than five taxa with nearby faunas, or excluding them if there are no nearby localities of comparable age. To minimize different identification effort between sites, I modified the faunal list to reflect the level of identification made in Natural Trap Cave: *Cynomys* species are grouped into the two subgenera, *Peromyscus* species are only counted as genus-level records, and ground squirrels grouped by currently-recognized genera (*Urocitellus*, *Xerospermophilus*, *Otospermophilus*, *Ictidomys*). Species accounts are grouped by genus if the genus was considered monotypic in the FAUNMAP database or the second species has fewer than five occurrences.

Binned faunas were grouped into regional ecosystems using UPGMA cluster analysis, completed with PAST (PAleontogical STatistics) v. 1.89 (Hammer et al., 2001). Simpson's Coefficient of Similarity is the most appropriate similarity measure to use for my clustering

algorithm given the nature of the database. Simpson's coefficient is defined as M/S, where M is the number of shared taxa and S is the number of taxa in the smaller sample. Simpson's coefficient of similarity minimizes the effects of taphonomy and geographic coverage of the dataset on the similarity matrix (Hammer and Harper, 2006). Resulting clusters from the 10–0 ka bin are used to set appropriate similarity cutoffs for regional ecosystems. The appropriate cutoff is set by comparing clusters with modern mammal provinces from Hagmeier and Stults (1964) (Fig. 22). The cutoff level that results in the most geographically cohesive units similar to modern mammal provinces is then used for each time bin. I subsequently map each cluster group by connecting the geographically outermost member localities.

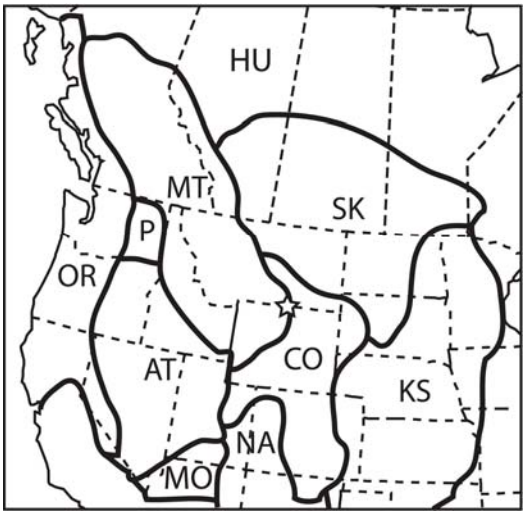


Figure 23. Modern mammal provinces for central western North America taken from Hagmeier and Stult (1964). Star represents location of Natural Trap Cave. Abbreviations: HU = Hudsonian, MT = Montanian, SK = Saskatchewan, P = Palusian, OR = Oregonian, AT = Artemesian, CO = Coloradan, KS = Kansan, MO = Mojavian, NA = Navahonian.

I assess regional ecosystem faunal change through time by combining the member localities' faunal lists and counting the percentage of taxa that persisted through each time period. Allowances are first made for the taxonomic reporting system in FAUNMAP, were taxa

are often reported as genera of indeterminate species. A genus of indeterminate species was only counted if it was present in all time bins under comparison and the reported member species were not. Otherwise, only species accounts and genera with no species reported (i.e., *Peromyscus* sp.) are counted. Furthermore, time intervals with similar sampling intensity are compared.

Results

The combined database yielded 294 individual samples with 112 taxa for the cluster analysis. The greatest number of samples in one time unit (189) is concentrated in the 10–0 ka bin, with the number decreasing to seven in the >100 ka bin (Fig. 23). The number of taxa does not substantially increase beyond a sample size of 100 however (Fig. 23).

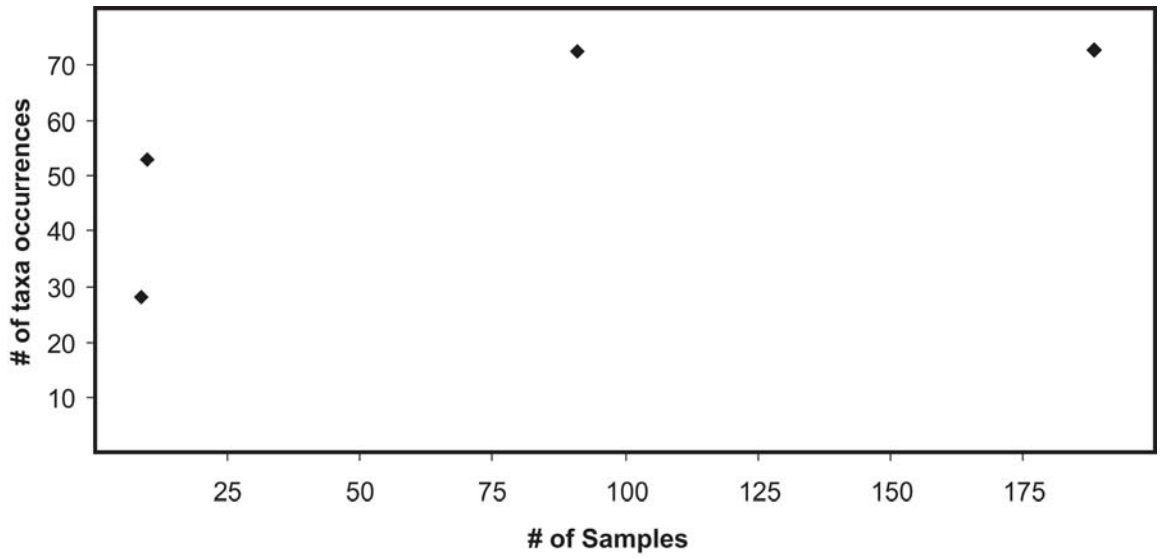


Figure 24. Number of samples (X-axis) and taxonomic occurrences (Y-axis) for each time bin.

The 10–0 ka bin sites cluster into faunal provinces most similar to modern mammal provinces at 35% similarity. This results in four locality clusters that occupy the geographic space of seven of Hagmeier and Stults' (1964) modern mammal provinces (Fig. 24): Oregonian, Palusian, Coloradan, Navahonian, Kansan, Saskatchewan, and Montanian. Province 1 (P1) most closely compares with the Montanian Province, but also occupies a portion of the modern Coloradan Province (Figs. 22 & 24). The physiographic regions encompassed are the Southern Rocky Mountains, Wyoming Basin, Middle Rocky Mountains, Northern Rocky Mountains, and portions of the Columbia Plateau and Cascade–Sierra Mountains. P1 also likely extended into the Canadian Rocky Mountain, but there are no FAUNMAP localities from this

time period. Province 2 (dark-gray polygon, Fig. 24) encompassed much of the northern Great Plains, occupied today by two modern mammal provinces, the Saskatchewan and Kansan provinces. Province 3 (light-gray polygon, Fig. 24) is most similar to the Coloradan Faunal Province in position, encompassing the northern Colorado Plateau. The two white rectangles are in Figure 24 are most similar to the Navahonian and Oregonian provinces, which are located in the central Colorado Plateau and Oregon Coast Range, respectively.

The P1 boundaries change through time, but no other province intrudes into the Wyoming Basin–Middle/North Rocky Mountain regions. P1 extended into the central Great Plains area during the Late Wisconsin time period (35–10 ka) time bins as well as expanding further south on the Colorado Plateau (Fig. 24). P1 also encompassed the Canadian Rocky Mountains as well as the northern Great Plains at times. The Canadian localities that are present cluster with P1 except within the 100–35 ka time bin. Natural Trap Cave is located at or near the northeastern edge of P1 throughout the record.

The proportion of species persisting throughout the time interval studied was relatively low for the complete dataset, 28%, but this may be due to the number of samples in each time interval (Fig. 23 & Table 13). I account for the number of samples per bin also by making additional comparisons between intervals with similar numbers of samples. The sample-size qualification resulted in two additional comparisons: 10–0 compared with 35–10 ka and 100–35 compared with >100 ka. The percentage of taxa persisting in each comparison was 69% and 47%, respectively.

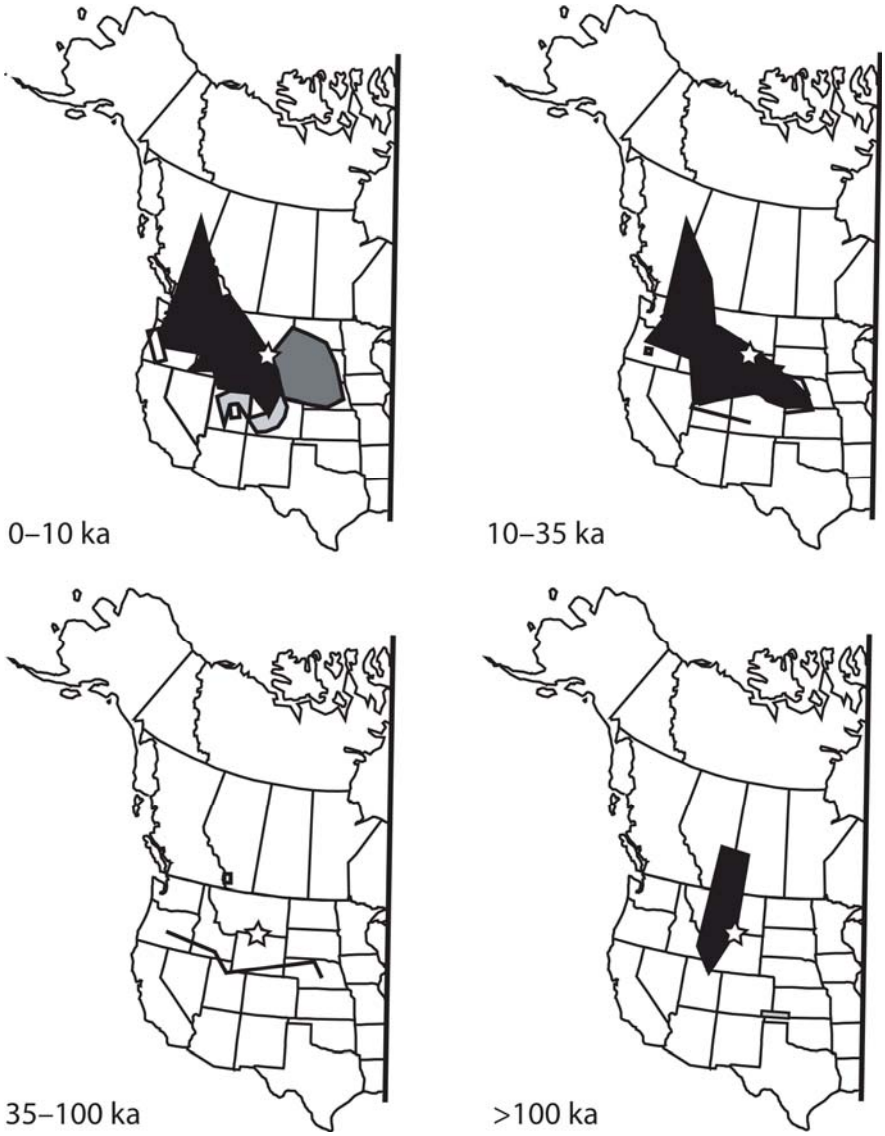


Figure 25. Geographic extent of 35% similar clustered faunas for each time interval. Province 1 (P1) is the black polygon in each map.

Taxa	10–0	35–10	100–35	>100
Ammospermophilus leucurus	X	X		
Aplodontia rufa	X			
Blarina brevicauda		X	X	
B. hylophaga			X	
Brachylagus idahoensis	X	X	X	X
Myodes sp.	X	X	X	X

Taxa	10–0	35–10	100–35	>100
Castor canadensis	X	X	X	X
Cryptotis parva			X	
Cynomys (*Cynomys*)	X	X		X
Cynomys (*Leucocrossuromys*)	X	X	X	X
Dipodomys sp.	X	X		
Dicrostonyx groenlandicus	X	X	X	
Erethizon dorsatum	X	X	X	X
Geomys sp.		X	X	
Glaucomys sp.	X			
Lemmiscus curtatus	X	X	X	X
Lemmus sibiricus		X		
Lepus americanus	X	X	X	X
L. californicus	X	X		
L. townsendii	X	X	X	X
Microtus longicaudus	X	X	X	X
M. miurus	X	X		
M. montanus	X	X	X	X
M. ochrogaster	X	X	X	
M. oeconomus	X	X		
M. pennsylvanicus	X	X	X	X
M. richardsoni	X	X	X	
M. xanthognathus	X	X	X	
Marmota caligata	X	X	X	
M. flaviventris	X	X	X	X
Neotoma cinerea	X	X	X	X
N. lepida	X	X		
Ochotona sp.	X	X	X	X
Onychomys sp.	X	X	X	
Ondatra sp.	X	X	X	X
Peromyscus sp.	X	X	X	X
Perognathus sp.	X	X	X	X
P. fasciatus		X		
P. formosus		X		
P. flavus	X	X		
P. parvus	X	X		
Chaetodipus hispidus		X		
Phenacomys sp.	X	X	X	X
Parascalops breweri			X	
Reithrodontomys sp.	X		X	

Taxa	10–0	35–10	100–35	>100
Scalopus aquaticus		X	X	
Sigmodon sp.	X			
Synaptomys sp.		X	X	
Synaptomys borealis	X	X		
Synaptomys cooperi	X		X	
Urocitellus sp.	X	X	X	X
Poliocitellus sp.			X	
Callospermophilus sp.	X	X		
Xerospermophilus sp.		X		
Ictidomys sp.	X	X	X	
Otospermophilus sp.	X	X		
Scapanus latimanus	X			
Sorex arcticus		X		
S. cinereus	X	X	X	
S. haydeni	X			
S. hoyi	X	X		X
S. merriami	X			
S. monticolus	X	X		
S. nanus	X	X		X
S. palustris	X	X	X	
S. scottensis		X	X	
S. vagrans	X	X		
Sylvilagus sp.	X	X	X	X
S. audubonii	X			
S. floridanus	X			X
S. nuttallii	X	X		X
Tamias dorsalis		X		
T. minimus	X	X	X	X
Tamiasciurus hudsonicus	X	X	X	
Thomomys bottae	X			
T. mazama	X			
T. scudderi			X	
T. talpoides	X	X	X	X
T. townsendii	X	X	X	X
T. umbrinus	X	X		
T. vetus			X	
Zapus sp.			X	
Z. hudsonicus		X		
Z. princeps	X	X		

Table 14. Taxa from the first province used in this study organized into time bins.

Discussion

The Holocene provinces delineated here are broadly similar to modern mammal provinces and most previous attempts at classifying Holocene provinces. The reconstructed province that Natural Trap Cave belongs to (P1) is geographically and taxonomically similar to the Montanian and northern Coloradan provinces of Hagmeier and Stults (1964). The modern Coloradan and Montanian provinces have a Simpson similarity index (0.64), higher than the cutoff point used here, so it is possible that the more montane Rocky Mountain section of the Coloradan Province has been grouped with the Montanian Province in my reconstructions. Graham et al. (1996), using the entire FAUNMAP database, also grouped all Holocene Rocky Mountain faunas into one province. Graham et al.'s (1996) Rocky Mountain Province also extended into the Great Basin; however, a result that this analysis might have replicated had Nevada been included.

The Pleistocene boundaries and taxonomic composition of P1 generally agree with those outlined by others. Early provincial maps are based on the distribution of a few important taxa, and usually include larger areas. The *Camelops* Faunal Province described by Martin and Neuner (1978) and Martin et al. (1985) encompasses the western United States, but the northeastern boundaries correspond with P1 described here. Graham (1979) also considered Wyoming to be the eastern boundary of a Pleistocene Rocky Mountain Province. Graham et al. (1996), using the FAUNMAP database, also noted a boundary running SE from western Montana to western Nebraska. Martin et al. (1985) and Graham et al. (1996) also describe a fauna for the Rocky Mountain area that is broadly similar to the clustering that P1 is based on. Graham et al. (1996) listed Northern Pocket Gopher (*Thomomys talpoides*), Bushy-tailed Woodrat (*Neotoma cinerea*), Sagebrush Vole (*Lemmiscus curtatus*), and American Pika

(*Ochotona princeps*) as indicator species for their Pleistocene Rocky Mountain Faunal Province. Martin et al. (1985) gave a similar list for their *Camelops* Faunal Province with some additions: Water Shrew (*Sorex palustris*), *O. princeps*, marmot (*Marmota* sp.), pocket gopher (*Thomomys* sp.), Bog Lemming (*Synaptomys* sp.), and Meadow Vole (*Microtus pennsylvanicus*). These taxa are characteristic also of P1 in this study. Other taxa present in P1 (Fig. 24 & Table 13) are Least Chipmunk (*Tamias minimus*), White-tailed Prairie Dogs (*Cynomys* sp.), Southern Red-backed Vole (*Myodes gapperi*), Montane Vole (*M. montanus*), Long-tailed Vole (*M. longicaudus*), Snowshoe Hare (*Lepus americanus*), and White-tailed Jackrabbit (*L. townsendii*). These species occur in the modern central and northern Rocky Mountain areas, although some were relegated in the Holocene to isolated alpine pockets.

The proportion of taxa that persist through time within a regional ecosystem is the primary measure of coordinated stasis. Brett et al. (1996) considered a regional ecosystem with 60–80% of the fauna retained over long time periods to be in coordinated stasis. P1 retained 28% of its member taxa throughout the study period, which would seem to indicate significant faunal change through time. The small sample size in the earliest time bins (100–35 ka, >100 ka) relative to the later time intervals makes this conclusion suspect however. I compared time intervals with similar sampling intensity and found a higher retention of taxa, with the proportion of the fauna carried over between the Late Wisconsin and Holocene time intervals (69%) within the coordinated stasis range of Brett et al. (1996). Riddle (1998) also noted faunal stability through time in the Rocky Mountain area, although with a more restricted dataset. Riddle (1998) found that the Rocky Mountain geomorphic province, which P1 encompasses, retained a stable rodent fauna with the only invading, and later extirpated, taxa being arctic lemmings (*Dicrostonyx* and *Lemmus*). I think that the early-mid Wisconsinan/last interglacial evidence

suggests that there was some regional faunal reorganization going into the last glacial period, but this seems suspect due to the aforementioned lack of sampling from early Wisconsinan time. On the whole there is strong evidence that the province was in faunal stasis during the last glacial cycle.

The local faunal stasis observed in Natural Trap Cave is therefore a reflection of provincial stasis in P1. Roy's (2001) provincial stability hypothesis is therefore a likely explanation for local stasis observed within Natural Trap Cave. The hypothesized position of Natural Trap Cave within P1 is relatively close to the NE boundary of the province in every time interval (Fig. 24), but proximity to the N and S boundaries is probably more important than the NE province border. The Bighorn Mountains, north and east of Natural Trap Cave, is a substantial barrier to dispersal and invasion which I think makes the NE province border a less significant influence on Natural Trap Cave than others. The Bighorn Mountains were glaciated during the LGM (Salisbury, 1906), which increased the effectiveness of the mountain range as a biogeographic barrier to East–West movement. The northern rim of the Bighorn Basin was probably the main portal for new dispersal into the basin. A likely route for dispersal to Natural Trap Cave from the north would be along the eastern slopes of the Absaroka Mountains and along the riparian corridor afforded by Clark's Fork of the Yellowstone River, and then either east through the Pryor Mountains, or south around the rim of the basin. Thus, the distance from the northwest provincial boundary is a more likely test of Roy's (2001) hypothesis. Late Pleistocene localities in the Canadian Rocky Mountains cluster with P1, except for the preglacial 100–35 ka interval, therefore Natural Trap Cave was probably near the center of the N–S province. The composition of the extreme northern P1 provincial faunas are generally similar to that of Natural Trap Cave, excepting the arctic invaders such as *Lemmus* and *Dicrostonyx*, which

is a likely indicator that relatively few new taxa would have been forced south by the glacial advance. The evidence in Natural Trap Cave shows that a similar situation happened during the last deglaciation. Relatively few extraprovincial southern taxa appeared in Natural Trap Cave within the Holocene unit, the Pallid Bat (*Antrozous pallidus*) is the primary example. Location within the province is consequently a probable cause for the local stasis observed in Natural Trap Cave.

Resilience of P1 to change is evidence the Quaternary glacial cycles were not severe enough to disrupt the Rocky Mountain regional ecosystem. Western North America's mountainous terrain has been hypothesized to be a prime center of glacially forced speciation through vicariance, but Quaternary speciation rates do not support this (Vrba, 1992; Lister, 2004). Phylogeographic patterns of several different modern taxa suggest pre-Quaternary geologic and climatic events as causes for speciation in western North America (reviewed in Jaeger et al., 2005). This could be due to the resilience of regional ecosystems of the Rocky Mountains. Much speciation and extinction in the fossil record occurs during ecosystem collapses (Brett et al., 1996). Less than 40% of lineages in an ecosystem typically persist through regional collapses in the fossil record (Brett et al., 1996).

The mountain barriers that prohibited dispersal in P1 also allowed it to incorporate taxa from other provinces, although usually restricting these invasions to the edges, while maintaining its core diversity. Prominent relief in the central and northern Rocky Mountains allows a variety of biomes, steppe and grassland in the low-lying basins, open conifer woodland in the foothills, cool conifer forest and tundra at higher elevations (Thompson and Anderson, 2000). The primary response of the P1 fauna to the last glacial cycle was an exchange of taxa on the edges with adjacent provinces. The elevational variability typically restricted these to the edges. The

eastern edges of P1 had a tendency to incorporate Great Plains taxa such as the Prairie Vole (*Microtus ochrogaster*), while the western edges were invaded by taxa more typical of the neighboring Oregonian Mammal Province, such as the Mountain Beaver (*Aplodontia rufa*). The northern arctic tundra taxa are the exception, because some members of the invading northern arctic group previously mentioned are the most pervasive in the province. Collared Lemmings (*Dicrostonyx groenlandicus*), which are restricted to modern tundra habitat, were present in eastern Idaho as well as northern and southern Wyoming during the Wisconsinan glaciation (Mead and Mead, 1989). There is evidence that at least some of the basin floors have soil features similar to those seen in modern tundra. Mears (1981) and Nissen and Mears (1990) found ice-wedge casts in late Pleistocene soils, a common sedimentary feature in permafrost soils, in Wyoming basins near the fossil occurrences of *Dicrostonyx*. Open conifer woodlands persisted at higher elevation though, allowing the core P1 fauna of mixed open (e.g., *Cynomys*, *Urocitellus*) and woodland species (e.g., *Tamiasciurus*) to persist in the area (Thompson and Anderson, 2000).

I believe the pattern observed at Natural Trap Cave further delineates the causes of coordinated stasis. There has been some argument as to whether ecological interactions or historical biogeography stabilize community membership. One example of an ecology-based hypothesis is "ecological locking" (Morris et al., 1995). Morris et al. (1995) theorized that ecological interactions between species in a community result in limited membership through character displacement and resource partitioning. Thus, competition with a limited community membership also confers stabilizing selection on member taxa, resulting in prevention of directional morphological evolution. Morris et al. (1995) noted that small isolated populations in general are usually eradicated rather than speciate due to the increased probability that high-

frequency processes (storms, fires, etc.) can decimate the group below a critical level. Hypotheses based on historical processes, such as that of Roy (2001), state that faunal stasis would be expected in paleocommunities geographically distant from provincial boundaries, due to historical inertia.

Within Natural Trap Cave and the faunal province as a whole, there is more evidence for the importance of topography and history in causing faunal stasis. Brown and Maurer (1991) noted that most North American small mammals have ranges that are elongated north–south and relatively narrow east–west. This trend is probably due to the sensitivity of small mammals to habitat types associated with major topographic features like mountains, valleys, etc. that are predominantly oriented N–S in North America (Brown and Maurer, 1991). The modern representatives of Natural Trap Cave small mammal distributions trend N–S (Fig. 21), which is reflected also in Hagmeier and Stults' (1964) Montanian mammal province and P1 (Figs. 22, 24). Therefore, the northern boundary of P1 was pushed further south during the Last Glacial Maximum and habitat upper elevation limits were depressed due to alpine glaciation, but the regional faunal membership remained similar because habitat tracking along the elevational cline was possible. Reconstructions of Rocky Mountain full glacial biomes based on pollen data, woodrat middens, and geomorphology find elevational variability in habitats during the Pleistocene: the lower elevational limit of tundra was depressed by 500 m, open conifer woodlands were plentiful at several elevations, and tundra-like conditions existed in the basin (Mears, 1981; Nissen and Mears, 1990; Thompson et al., 1993, Thompson and Anderson, 2000). The general climate was colder and dryer than today due to the splitting of the Gulf Stream by the Laurentide Ice Sheet (Thompson et al., 1993), but the range of habitat types necessary to

retain provincial biodiversity seems to have persisted. Habitat tracking within the Rocky Mountain area was the primary response of the provincial fauna rather than regional extinction. The persistence of the Natural Trap Cave small mammal taxa through a glacial cycle with little morphological change has implications for the study of punctuated equilibrium. Lister (2004) found subspecific variation to be the norm in numerous Holarctic examples and noted little speciation associated with the last Quaternary glacial cycle. Long (1965) attributed most subspecific variation in Wyoming rodents to the influence of the last glacial cycle, especially the number of endemic subspecies in the Bighorn Mountains, implying that the general Quaternary pattern applied regionally in the Rocky Mountains as well. The lack of speciation during the Quaternary is evidence that the glacial cycles are not long enough to permit speciation to occur or that in most cases the barriers formed during the cycles are ineffectual isolators. Most mammalian speciation is recognized as allopatric, so the creation of more effective long-term barriers within a species range would increase the likelihood of speciation, although paradoxically the probability of extinction would also likely increase due to a smaller geographic range. The destruction of a regional ecosystem in the middle of a species' range would create a large, effective barrier between populations. This scenario is predicted by Eldredge's (2003) 'sloshing bucket' model of evolution. Destruction of lower level ecological entities like communities or partial regional ecosystem reorganization would result in loss of individual demes within species, but not extinction or speciation. Eldredge (2003) predicted larger ecological disruptions are necessary to cause speciation and extinction. According to the Rocky Mountain evidence I outlined above, glacial cycles are not effective disruptors of temperate regional ecosystems where elevation allows species' distributions to follow ideal habitat.

A stronger case exists for glacially forced speciation in arctic mammals. The continental glaciers undoubtedly destroyed arctic biomes, because abundant evidence exists that the reconstituted arctic biomes are composed of a mosaic of species that followed the retreating ice sheets at different rates. Pollen records for example, document the sporadic spread north of different tree species during the deglaciation at a rate governed by species' seed dispersal methods (Williams et al., 2001). The potential for speciation is therefore probably highest in northern latitudes, due to the effective isolation imposed by continental glacier. Increased speciation potential is reflected in modern North American bird and mammal phylogenies. Weir and Schluter (2007) described a linear correlation between latitude and various measures of phylogenetic splitting in molecular phylogenies, younger species occur further north and older species occur further south in North America.

Conclusions

The small mammal province of which Natural Trap Cave is a member of (P1) maintained a relatively consistent membership (47–69% retained taxa) throughout the last glacial cycle. The province was also consistent in being centered in the central Rocky Mountains. The faunal province is similar taxonomically and spatially to those described by others. The location of Natural Trap Cave relative to the northern and southern provincial borders, those with the fewest barriers and therefore most susceptible to dispersal, corroborates the provincial pattern for stasis described by Roy (2001) for Pleistocene mollusks of California. Less significant faunal change was experienced at Natural Trap Cave because it was located relatively distant from northern and southern provincial borders. A change in timing of glacial cycles, intensification of glaciation, or a change in the geography, such as a mountain-building event, would be required to break the biogeographic inertia in the Rocky Mountains.

SUMMARY OF CONCLUSIONS

Natural Trap Cave is an important record of mammalian response to climate change across glacial cycles, with a continuous sedimentary record including at least 21 small mammal taxa. Woodrats accumulated the fauna from bone and scat deposited near the cave entrance by several different types of predators. Raptors were responsible for a large proportion of the small mammal taxa, as well as waterfowl and fish found in the cave, leading to the conclusion that the cave collecting radius includes at least all of Little Mountain and some of the adjoining Bighorn River. The fauna is located along an elevational cline and provides important information regarding the depression of alpine biomes down-elevation during the Last Glacial Maximum, as well as the influence of arctic tundra forced south by continental glaciation.

The Natural Trap Cave fauna was statistically static in membership during the last glacial cycle, an important result juxtaposed with the extreme change documented elsewhere. Abundant evidence in Quaternary paleobotanical and paleontological records points to the ephemeral nature of communities, and in many cases regional ecosystems and continental biotas, in the face of glacial advances and retreats. I found the small mammal faunal stasis in Natural Trap Cave points to the importance of geography and species habitat specificity as the mediator of change. Natural Trap Cave is located in a modern mammal faunal province characterized by a heterogeneous topography that provides multiple barriers to east–west movement, but encourages north–south habitat tracking. Thus, the primary direction of range shifting during the last glacial cycle was movement down-elevation by boreal montane species (e.g. American Pika, Yellow-bellied Marmot, Gapper's Red-backed Vole) and a secondary movement following the northwest–southeast directional trend of the Central Rocky Mountains (Collared Lemming, Arctic Hare, Singing Vole, Northern Bog Lemming, White-tailed Jackrabbit, Pallid Bat).

Natural Trap Cave is distant from the northwest and southeast edges of its faunal province, insulating the local fauna from outside influences. The local faunal component responsible for stasis are generalists that can be found in multiple habitats, or at least in the open steppe favored by the relatively flat topography and historical aridity of Little Mountain. An event more extreme than glacial climate change would be required to extirpate these taxa from the Natural Trap Cave area. Thus, in the case of Natural Trap Cave, community stasis is not a pattern resulting from special properties of communities, but caused by geography.

The Natural Trap Cave fauna also has implications for the study of macroevolution during the Quaternary. The invading arctic species are much more likely to have faced conditions likely for speciation than the cordilleran/boreal taxa constantly present at Natural Trap Cave. The distributions of the arctic taxa, continuous during interglacials, were likely split as the forming Laurentide Ice Sheet pushed western and eastern populations in different directions. This hypothesis is supported by a latitudinal trend in the ages of splits in molecular phylogenies of birds and mammals. Further study of arctic small mammals is likely to provide examples of glacially forced speciation.

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APPENDICES

Appendix 1.1. Heteromyidae and Cricetidae

Cat. ID	ID	Square	Unit	Side	element	dentition
147984	*Perognathus* sp.	510NW505	Unit 6 (>100 ka)	L	dent.	m
147985	*Perognathus* sp.	505N	Unit 6 (>100 ka)	L	dent.	i1 m1-m3
147986	*Perognathus* sp.	510NW505	Unit 6 (>100 ka)	L	dent.	p4 m1m2
147987	*Perognathus* sp.	510NW505	possibly Unit 6	L & R	max.	
147988	*Perognathus* sp.	505N	Unit 6 (>100 ka)	R	dent.	p4 m1
147989	*Perognathus* sp.	505N	Unit 6 (>100 ka)	R	dent.	i1 p4m1m2
147990	*Perognathus* sp.	505NW505	Unit 6 (>100 ka)	R	max.	
147991	*Perognathus* sp.	505NW505	possibly Unit 6	L	max.	
147992	*Perognathus* sp.	510NW505	possibly Unit 6	R	dent.	p4
147993	*Perognathus* sp.	505NW505	possibly Unit 6	L	dent.	i1 p4m1m2
147994	*Perognathus* sp.	510NW505	possibly Unit 6	R	dent.	m2-3
148197	*Perognathus* sp.	525NW485	Unit 1 (10–0 ka)	R	dent.	i1
148401	*Perognathus* sp.	510NW505	Unit 6 (>100 ka)	L	dent.	edent.
148434	*Perognathus* sp.	510NW500	possibly Unit 2	R	dent.	i1
148633	*Perognathus* sp.	580NW465	possibly Unit 3	L	dent.	p4
148634	*Perognathus* sp.	520NW490	Unit 2 (12–14 ka)	R	dent.	i1
148635	*Perognathus* sp.	520NW510	Unit 2 (12–14 ka)	R	dent.	i1 p4
148636	*Perognathus* sp.	520NW490	Unit 3 (17–20 ka)	R	dent.	i1 p4
148637	*Perognathus* sp.	520NW490	Unit 2 (12–14 ka)	R	dent.	i1
149036	*Perognathus* sp.	520NW490	Unit 2 (12–14 ka)	L	dent.	i1
148898	*Perognathus* sp.	520NW490	Unit 2 (12–14 ka)	L	dent.	i1, m2
148899	*Perognathus* sp.	520NW490	Unit 2 (12–14 ka)	R	dent.	i1 p4-m2
149299	*Perognathus* sp.	510NW505	possibly Unit 6	L	dent.	edent.
149330	*Perognathus* sp.	510NW505	Unit 6 (>100 ka)	L	dent.	p4
149333	*Perognathus* sp.	500NW505	possibly Unit 6	L	dent.	edent.
149336	*Perognathus* sp.	500NW505	possibly Unit 6	L	dent.	edent.
149347	*Perognathus* sp.	510N	Unit 6 (>100 ka)	L	dent.	i1
149354	*Perognathus* sp.	505N	Unit 6 (>100 ka)	L	dent.	edent.
149355	*Perognathus* sp.	505N	Unit 6 (>100 ka)	R	dent.	i1
149356	*Perognathus* sp.	505N	Unit 6 (>100 ka)	R	dent.	i1
149357	*Perognathus* sp.	505N	Unit 6 (>100 ka)	R	dent.	edent.
26654	*Peromyscus* sp.	525NW485	Unit 3 (17–20 ka)	L	dent.	i1 m1
64590	*Peromyscus* sp.	520NW505	Unit 2 (12–14 ka)	R	dent.	complete
64591	*Peromyscus* sp.	520NW505	Unit 2 (12–14 ka)	L	dent.	m1-3
64592	*Peromyscus* sp.	520NW505	Unit 2 (12–14 ka)	R	dent.	complete
64593	*Peromyscus* sp.	520NW505	Unit 2 (12–14 ka)	R	dent.	i1 m1
64594	*Peromyscus* sp.	520NW505	Unit 2 (12–14 ka)	R	dent.	i1 m1-2
64595	*Peromyscus* sp.	520NW505	Unit 2 (12–14 ka)	R	dent.	i1 m1-2
64596	*Peromyscus* sp.	520NW505	Unit 2 (12–14 ka)	L	dent.	i1 m1-2
64597	*Peromyscus* sp.	520NW505	Unit 2 (12–14 ka)	L	dent.	i1 m1-2
64598	*Peromyscus* sp.	520NW505	Unit 2 (12–14 ka)	L	dent.	i1 m1
64600	*Peromyscus* sp.	520NW505	Unit 2 (12–14 ka)	L	dent.	complete
64601	*Peromyscus* sp.	520NW505	Unit 2 (12–14 ka)	R	dent.	i1 m1
64659	*Peromyscus* sp.	480NW515	?	R	dent.	m1-2
64661	*Peromyscus* sp.	480NW515	?	L	dent.	m1-2

64662	*Peromyscus* sp.	480NW515	?	L	max.	M1-2
64666	*Peromyscus* sp.	500NW450	?	L	dent.	i1 m1-2
64700	*Peromyscus* sp.	?	?	R	dent.	complete
64703	*Peromyscus* sp.	?	?	L	dent.	complete
64706	*Peromyscus* sp.	no data	?	R	dent.	i1 m1
64708	*Peromyscus* sp.	contiguous square	?	R	dent.	i1 m1-2
64714	*Peromyscus* sp.	slump	?	L	dent.	i1 m1
64721	*Peromyscus* sp.	?	?	R	dent.	complete
64734	*Peromyscus* sp.	510NW500	Unit 3 (17–20 ka)	L	dent.	m1
64740	*Peromyscus* sp.	500NW450	Unit 1 (10–0 ka)	L	dent.	i1 m1-2
64751	*Peromyscus* sp.	500NW450	Unit 1 (10–0 ka)	R	dent.	m1
64787	*Peromyscus* sp.	510NW500	Unit 1 (10–0 ka)	R	dent.	i1 m1
64788	*Peromyscus* sp.	510NW500	Unit 1 (10–0 ka)	L	dent.	m1-2
64789	*Peromyscus* sp.	510NW500	Unit 1 (10–0 ka)	L	dent.	complete
64796	*Peromyscus* sp.	480NW515	?	L	max.	M1-3
67932	*Peromyscus* sp.	510NW500	?	L	dent.	i1, m1-3
68226	*Peromyscus* sp.	525NW485	Unit 1 (10–0 ka)	R	dent.	i1 m1-2
68230	*Peromyscus* sp.	525NW485	Unit 1 (10–0 ka)	L	max.	M1-3
68241	*Peromyscus* sp.	525NW485	Unit 1 (10–0 ka)	R	dent.	complete
68242	*Peromyscus* sp.	525NW485	Unit 1 (10–0 ka)	L	dent.	i1 m1
68243	*Peromyscus* sp.	525NW485	Unit 1 (10–0 ka)	L	dent.	complete
68244	*Peromyscus* sp.	525NW485	Unit 1 (10–0 ka)	L	dent.	complete
68245	*Peromyscus* sp.	525NW485	Unit 1 (10–0 ka)	L	dent.	complete
68246	*Peromyscus* sp.	525NW485	Unit 1 (10–0 ka)	R	dent.	complete
68247	*Peromyscus* sp.	525NW485	Unit 1 (10–0 ka)	R	dent.	complete
68248	*Peromyscus* sp.	525NW485	Unit 1 (10–0 ka)	R	dent.	i1 m1-2
68249	*Peromyscus* sp.	525NW485	Unit 1 (10–0 ka)	L	dent.	complete
68520	*Peromyscus* sp.	510NW485	Unit 2 (12–14 ka)	R	dent.	i1 m1-2
97316	*Peromyscus* sp.	?	?	R	dent.	i1 m1
97346	*Peromyscus* sp.	517NW515	?	R	dent.	i1 m1
97389	*Peromyscus* sp.	515NW485	Unit 2 (12–14 ka)	L	dent.	i1 m1
97461	*Peromyscus* sp.	517NW515	?	L	dent.	i1 m1
124049	*Peromyscus* sp.	500NW510	?	L	dent.	i1 m1
147017	*Peromyscus* sp.	500NW505	Unit 6 (>100ka)	L	dent.	complete
147072	*Peromyscus* sp.	520NW505	Unit 2 (12–14 ka)	L	max.	M2
147996	*Peromyscus* sp.	510NW505	Unit 6 (>100ka)	L	max.	M1-2
147997	*Peromyscus* sp.	510NW505	?	L	max.	M1-2
147998	*Peromyscus* sp.	510NW505	Unit 6 (>100ka)	R	max.	M1-2
147999	*Peromyscus* sp.	510NW505	Unit 6 (>100ka)	R	max.	M1-2
148000	*Peromyscus* sp.	510NW505	?	R	max.	M1-3
148001	*Peromyscus* sp.	520NW505	Unit 2 (12–14 ka)	R	max.	M3
148002	*Peromyscus* sp.	520NW495	Unit 1 (10–0 ka)	L	max.	M1
148003	*Peromyscus* sp.	510NW505	?	R	max.	M1-2
148004	*Peromyscus* sp.	525NW485	Unit 1 (10–0 ka)	R	max.	M1
148005	*Peromyscus* sp.	510NW505	?	R	max.	M1
148006	*Peromyscus* sp.	505NW505	?	R	max.	M1-3
148007	*Peromyscus* sp.	510N	Unit 6 (>100ka)	R	max.	M1
148008	*Peromyscus* sp.	505N	Unit 6 (>100ka)	R	max.	M1-2
148009	*Peromyscus* sp.	510NW505	Unit 6 (>100ka)	L	max.	M1-3
148010	*Peromyscus* sp.	495-500NW515	Unit 6 (>100ka)	R	max.	M1-3

148011	*Peromyscus* sp.	505N	Unit 6 (>100ka)	L	max.	M1-3
148012	*Peromyscus* sp.	505NW505	?	R	max.	M1
148013	*Peromyscus* sp.	505NW505	Unit 6 (>100ka)	R	max.	M1
148014	*Peromyscus* sp.	505NW505	Unit 6 (>100ka)	R	max.	M1
148015	*Peromyscus* sp.	505NW505	?	L	max.	M1-2
148016	*Peromyscus* sp.	505N	Unit 6 (>100ka)	L	max.	M!-2
148017	*Peromyscus* sp.	510NW505	?	L	max.	M1
148018	*Peromyscus* sp.	505NW505	?	R	max.	M1-2
148019	*Peromyscus* sp.	510NW505	Unit 6 (>100ka)	R	max.	M1-2
148020	*Peromyscus* sp.	510N	Unit 6 (>100ka)	L	max.	M1-2
148021	*Peromyscus* sp.	510NW505	Unit 6 (>100ka)	L	max.	M1-2
148022	*Peromyscus* sp.	505NW505	?	L	max.	M1
148023	*Peromyscus* sp.	510NW505	Unit 6 (>100ka)	R	max.	M1
148024	*Peromyscus* sp.	495-500NW515	Unit 6 (>100ka)	L	max.	M1-2
148025	*Peromyscus* sp.	500NW505	Unit 6 (>100ka)	R	max.	M1-3
148026	*Peromyscus* sp.	500NW505	Unit 6 (>100ka)	R	max.	M1
148027	*Peromyscus* sp.	510NW505	Unit 6 (>100ka)	L	max.	M1-2
148028	*Peromyscus* sp.	510NW505	?	L	max.	M1
148029	*Peromyscus* sp.	505N	Unit 6 (>100ka)	L	max.	M1-2
148030	*Peromyscus* sp.	495-500NW515	Unit 6 (>100ka)	R	dent.	i1 m1-3
148032	*Peromyscus* sp.	495-500NW515	Unit 6 (>100ka)	L	dent.	m1-2
148033	*Peromyscus* sp.	510NW505	Unit 6 (>100ka)	L	dent.	i1 m1-2
148034	*Peromyscus* sp.	510N	Unit 6 (>100ka)	L	dent.	i1 m1-2
148035	*Peromyscus* sp.	510NW505	Unit 6 (>100ka)	R	dent.	i1 m1
148036	*Peromyscus* sp.	505NW505	Unit 6 (>100ka)	L	dent.	i1 m1-2
148037	*Peromyscus* sp.	495-500NW515	Unit 6 (>100ka)	L	dent.	i1 m1
148038	*Peromyscus* sp.	505NW505	?	R	dent.	i1 m1-2
148039	*Peromyscus* sp.	505N	Unit 6 (>100ka)	L	dent.	m1
148040	*Peromyscus* sp.	500NW505	Unit 6 (>100ka)	R	dent.	m1
148041	*Peromyscus* sp.	510N	Unit 6 (>100ka)	R	dent.	m1
148042	*Peromyscus* sp.	510N	Unit 6 (>100ka)	R	dent.	m1-2
148043	*Peromyscus* sp.	510NW505	Unit 6 (>100ka)	L	dent.	i1 m1
148044	*Peromyscus* sp.	510NW505	Unit 6 (>100ka)	R	dent.	i1 m1-2
148045	*Peromyscus* sp.	510NW505	Unit 6 (>100ka)	L	dent.	i1 m1
148046	*Peromyscus* sp.	495-500NW515	Unit 6 (>100ka)	R	dent.	m1-2
148047	*Peromyscus* sp.	505NW505	Unit 6 (>100ka)	R	dent.	m3
148048	*Peromyscus* sp.	505NW505	?	L	dent.	i1 m1-2
148049	*Peromyscus* sp.	505N	Unit 6 (>100ka)	L	dent.	i1 m1
148050	*Peromyscus* sp.	510NW505	Unit 6 (>100ka)	L	dent.	i1 m1-2
148051	*Peromyscus* sp.	510NW505	Unit 6 (>100ka)	L	dent.	i1 m1
148052	*Peromyscus* sp.	495-500NW515	Unit 6 (>100ka)	R	dent.	i1 m1-2
148053	*Peromyscus* sp.	500NW505	Unit 6 (>100ka)	L	dent.	i1 m2
148054	*Peromyscus* sp.	520NW495	Unit 1 (10–0 ka)	R	dent.	i1 m1-2
148056	*Peromyscus* sp.	505NW505	Unit 6 (>100ka)	R	dent.	i1 m2
148057	*Peromyscus* sp.	510NW505	?	L	dent.	m2
148058	*Peromyscus* sp.	510N	Unit 6 (>100ka)	L	dent.	i1 m1-2
148059	*Peromyscus* sp.	510N	Unit 6 (>100ka)	R	dent.	m1
148060	*Peromyscus* sp.	510NW505	Unit 6 (>100ka)	L	dent.	i1 m1
148061	*Peromyscus* sp.	495-500NW515	Unit 6 (>100ka)	L	dent.	i1 m1
148062	*Peromyscus* sp.	510NW505	Unit 6 (>100ka)	L	dent.	i1 m1

148063	*Peromyscus* sp.	505NW485	Unit 2 (12–14 ka)	R	dent.	m2
148064	*Peromyscus* sp.	505NW505	?	L	max.	m2-3
148065	*Peromyscus* sp.	?	Unit 6 (>100ka)	R	dent.	m2
148066	*Peromyscus* sp.	505NW505	?	L	dent.	i1 m2
148067	*Peromyscus* sp.	510NW505	Unit 6 (>100ka)	R	dent.	i1 m1
148068	*Peromyscus* sp.	495-500NW515	Unit 6 (>100ka)	L	dent.	i1 m2
148069	*Peromyscus* sp.	505NW505	Unit 6 (>100ka)	L	dent.	m2
148070	*Peromyscus* sp.	510NW505	?	R	dent.	i1 m2
148071	*Peromyscus* sp.	505NW505	Unit 6 (>100ka)	R	dent.	m1-2
148072	*Peromyscus* sp.	500NW450	Unit 1 (10–0 ka)	L	dent.	i1 m2
148073	*Peromyscus* sp.	505NW505	Unit 6 (>100ka)	L	dent.	m1-2
148074	*Peromyscus* sp.	510NW505	?	L	dent.	i1 m2
148075	*Peromyscus* sp.	520NW505	Unit 2 (12–14 ka)	L	dent.	i1 m1
148076	*Peromyscus* sp.	520NW505	Unit 2 (12–14 ka)	R	dent.	m2
148077	*Peromyscus* sp.	520NW505	Unit 2 (12–14 ka)	R	dent.	m1
148078	*Peromyscus* sp.	510NW505	?	L	dent.	m3
148079	*Peromyscus* sp.	520NW505	Unit 2 (12–14 ka)	R	dent.	m2
148080	*Peromyscus* sp.	510NW505	?	R	dent.	i1 m2-3
148081	*Peromyscus* sp.	495-500NW515	Unit 6 (>100ka)	L	dent.	complete
148082	*Peromyscus* sp.	?	Unit 6 (>100ka)	L	dent.	complete
148083	*Peromyscus* sp.	510NW505	Unit 6 (>100ka)	R	dent.	complete
148084	*Peromyscus* sp.	520NW505	Unit 2 (12–14 ka)	R	dent.	complete
148085	*Peromyscus* sp.	505NW505	Unit 6 (>100ka)	L	dent.	complete
148086	*Peromyscus* sp.	500NW505	Unit 6 (>100ka)	L	dent.	complete
148087	*Peromyscus* sp.	510NW505	Unit 6 (>100ka)	L	dent.	complete
148088	*Peromyscus* sp.	495-500NW515	Unit 6 (>100ka)	L	dent.	complete
148089	*Peromyscus* sp.	500NW450	Unit 1 (10–0 ka)	R	dent.	complete
148090	*Peromyscus* sp.	505NW505	?	L	dent.	complete
148091	*Peromyscus* sp.	505NW505	?	R	dent.	complete
148092	*Peromyscus* sp.	520NW505	Unit 2 (12–14 ka)	R	dent.	complete
148093	*Peromyscus* sp.	505NW505	Unit 6 (>100ka)	L	dent.	complete
148094	*Peromyscus* sp.	505NW505	?	L	dent.	complete
148095	*Peromyscus* sp.	505N	Unit 6 (>100ka)	L	dent.	complete
148096	*Peromyscus* sp.	510NW505	?	R	dent.	complete
148097	*Peromyscus* sp.	505N	Unit 6 (>100ka)	L	dent.	complete
148098	*Peromyscus* sp.	510NW505	Unit 6 (>100ka)	L	dent.	complete
148099	*Peromyscus* sp.	510NW505	?	R	dent.	complete
148100	*Peromyscus* sp.	510NW505	Unit 6 (>100ka)	R	dent.	complete
148101	*Peromyscus* sp.	510NW505	Unit 6 (>100ka)	R	dent.	complete
148102	*Peromyscus* sp.	510NW505	?	L	dent.	complete
148103	*Peromyscus* sp.	510NW505	?	R	dent.	complete
148104	*Peromyscus* sp.	510NW505	Unit 6 (>100ka)	R	dent.	complete
148105	*Peromyscus* sp.	500NW505	Unit 6 (>100ka)	R	dent.	complete
148106	*Peromyscus* sp.	510NW505	?	L	dent.	i1 m1
148107	*Peromyscus* sp.	510NW505	?	R	dent.	i1 m1
148108	*Peromyscus* sp.	?	Unit 6 (>100ka)	L	dent.	i1 m1-2
148109	*Peromyscus* sp.	510NW505	Unit 6 (>100ka)	L	dent.	i1 m1-2
148110	*Peromyscus* sp.	500NW450	Unit 1 (10–0 ka)	R	dent.	i1 m1
148111	*Peromyscus* sp.	520NW505	Unit 2 (12–14 ka)	R	dent.	i1 m1
148112	*Peromyscus* sp.	500NW505	?	L	dent.	i1 m1

148113	*Peromyscus* sp.	520NW505	Unit 2 (12–14 ka)	R	dent.	i1 m2
148114	*Peromyscus* sp.	505NW505	?	R	dent.	i1 m1-3
148115	*Peromyscus* sp.	505N	Unit 6 (>100ka)	R	dent.	i1 m2
148116	*Peromyscus* sp.	505NW505	Unit 6 (>100ka)	L	dent.	i1 m1-3
148117	*Peromyscus* sp.	505NW505	Unit 6 (>100ka)	L	dent.	i1 m1-3
148118	*Peromyscus* sp.	505NW505	?	R	dent.	m1
148119	*Peromyscus* sp.	505NW505	?	R	dent.	i1 m1-2
148120	*Peromyscus* sp.	510NW505	Unit 6 (>100ka)	L	dent.	i1 m1
148121	*Peromyscus* sp.	505N	Unit 6 (>100ka)	R	dent.	i1 m1-2
148122	*Peromyscus* sp.	520NW495	Unit 1 (10–0 ka)	R	dent.	i1 m1
148123	*Peromyscus* sp.	520NW505	Unit 2 (12–14 ka)	L	dent.	m1
148124	*Peromyscus* sp.	510NW505	Unit 6 (>100ka)	L	dent.	i1 m1-2
148125	*Peromyscus* sp.	500NW505	?	R	dent.	i1 m1-2
148126	*Peromyscus* sp.	?	Unit 6 (>100ka)	L	dent.	i1 m1
148127	*Peromyscus* sp.	520NW505	Unit 2 (12–14 ka)	R	dent.	i1 m1-2
148128	*Peromyscus* sp.	520NW505	Unit 2 (12–14 ka)	L	dent.	m1-2
148129	*Peromyscus* sp.	500NW450	Unit 1 (10–0 ka)	R	dent.	i1 m1
148130	*Peromyscus* sp.	510NW500	Unit 1 (10–0 ka)	L	dent.	i1 m1
148131	*Peromyscus* sp.	505NW505	?	L	dent.	i1 m1
148132	*Peromyscus* sp.	505NW505	?	R	dent.	m1-2
148133	*Peromyscus* sp.	510NW505	Unit 6 (>100ka)	L	dent.	m1
148134	*Peromyscus* sp.	510NW505	Unit 6 (>100ka)	L	dent.	i1 m1-3
148135	*Peromyscus* sp.	510NW505	?	R	dent.	m1
148136	*Peromyscus* sp.	510NW505	?	R	dent.	i1 m1-2
148137	*Peromyscus* sp.	517NW515	?	L	dent.	i1, m1
148138	*Peromyscus* sp.	505NW505	?	R	max.	M1-2
148202	*Peromyscus* sp.	505N	Unit 6 (>100ka)	L	max.	M1
148203	*Peromyscus* sp.	510NW505	?	L	max.	M1
148211	*Peromyscus* sp.	510NW500	?	L	dent.	i1, m2-m3
148251	*Peromyscus* sp.	510NW500	Unit 1 (10–0 ka)	L	dent.	i1, m1
148280	*Peromyscus* sp.	495NW510	?	R	dent.	i1, m1-2
148324	*Peromyscus* sp.	520NW520	Unit 3 (17–20 ka)	L	dent.	i1, m1-2
148465	*Peromyscus* sp.	525NW485	Unit 1 (10–0 ka)	L	max.	M2
148937	*Peromyscus* sp.	520NW510	Unit 2 (12–14 ka)	R	dent.	m1-3
148938	*Peromyscus* sp.	520NW510	Unit 2 (12–14 ka)	R	max.	M1-2
148939	*Peromyscus* sp.	520NW510	Unit 2 (12–14 ka)	R	dent.	i1 m1
148940	*Peromyscus* sp.	520NW490	Unit 2 (12–14 ka)	L	dent.	i1 m1-3
148941	*Peromyscus* sp.	520NW490	Unit 2 (12–14 ka)	L	dent.	i1 m1-2
148942	*Peromyscus* sp.	520NW490	Unit 2 (12–14 ka)	L	dent.	i1 m1-3
148943	*Peromyscus* sp.	520NW490	Unit 2 (12–14 ka)	L	dent.	i1 m1-2
148944	*Peromyscus* sp.	520NW490	Unit 2 (12–14 ka)	L	dent.	i1 m1-2
148945	*Peromyscus* sp.	520NW490	Unit 2 (12–14 ka)	L	dent.	m1-2
148946	*Peromyscus* sp.	520NW490	Unit 2 (12–14 ka)	L	dent.	i1 m1-2
148947	*Peromyscus* sp.	520NW490	Unit 2 (12–14 ka)	L	dent.	m1
148948	*Peromyscus* sp.	520NW490	Unit 2 (12–14 ka)	L	dent.	i1 m1-2
148949	*Peromyscus* sp.	520NW490	Unit 2 (12–14 ka)	L	dent.	i1 m1 m3
148950	*Peromyscus* sp.	520NW490	Unit 2 (12–14 ka)	L	dent.	i1 m1
148951	*Peromyscus* sp.	520NW490	Unit 2 (12–14 ka)	L	dent.	i1 m1-2
148952	*Peromyscus* sp.	520NW490	Unit 2 (12–14 ka)	R	dent.	m1
148953	*Peromyscus* sp.	520NW490	Unit 2 (12–14 ka)	R	dent.	i1 m1-2

148954	*Peromyscus* sp.	520NW490	Unit 2 (12–14 ka)	R	dent.	m1
148955	*Peromyscus* sp.	520NW490	Unit 2 (12–14 ka)	R	dent.	m1-3
148956	*Peromyscus* sp.	520NW490	Unit 2 (12–14 ka)	R	dent.	i1 m1-2
148957	*Peromyscus* sp.	520NW490	Unit 2 (12–14 ka)	R	dent.	m1-2
148958	*Peromyscus* sp.	495NW515	Unit 4 (20–24 ka)	R	dent.	i1 m2
148959	*Peromyscus* sp.	520NW490	Unit 2 (12–14 ka)	R	dent.	m1-m3
148960	*Peromyscus* sp.	520NW490	Unit 2 (12–14 ka)	R	dent.	i1 m1
148961	*Peromyscus* sp.	520NW490	Unit 2 (12–14 ka)	R	dent.	i1 m1
148962	*Peromyscus* sp.	520NW490	Unit 2 (12–14 ka)	R	dent.	i1 m1
148963	*Peromyscus* sp.	520NW490	Unit 2 (12–14 ka)	R	dent.	i1 m1-2
148964	*Peromyscus* sp.	520NW490	Unit 2 (12–14 ka)	R	dent.	i1 m1-3
148965	*Peromyscus* sp.	500NW515	Unit 3 (17–20 ka)	R	dent.	i1 m1
148966	*Peromyscus* sp.	495NW515	?	R	dent.	i1 m1
148967	*Peromyscus* sp.	495NW515	Unit 4 (20–24 ka)	R	dent.	m2
148969	*Peromyscus* sp.	495NW515	Unit 3 (17–20 ka)	R	dent.	m1
148970	*Peromyscus* sp.	495NW515	Unit 4 (20–24 ka)	L	dent.	m1
148971	*Peromyscus* sp.	495NW515	Unit 3 (17–20 ka)	L	dent.	i1 m2
148972	*Peromyscus* sp.	520NW490	Unit 2 (12–14 ka)	R	dent.	i1
148973	*Peromyscus* sp.	505NW535	Unit 3 (17–20 ka)	R	dent.	m1 m2
148974	*Peromyscus* sp.	520NW490	Unit 3 (17–20 ka)	L	dent.	m1
148975	*Peromyscus* sp.	495NW515	?	L	dent.	i1 m1 m3
148976	*Peromyscus* sp.	495NW515	?	L	dent.	i1 m1m2
148977	*Peromyscus* sp.	495NW515	?	L	dent.	i1 m1m2
148978	*Peromyscus* sp.	495NW515	?	R	dent.	i1 m1m2
148979	*Peromyscus* sp.	520NW490	Unit 2 (12–14 ka)	L	dent.	i1 m1m2
148980	*Peromyscus* sp.	520NW490	Unit 2 (12–14 ka)	L	dent.	i1 m1m2
148981	*Peromyscus* sp.	520NW490	Unit 2 (12–14 ka)	R	dent.	i1 m1
148982	*Peromyscus* sp.	520NW490	Unit 2 (12–14 ka)	L	dent.	i1 m1-3
148983	*Peromyscus* sp.	520NW490	Unit 2 (12–14 ka)	R	max.	
148984	*Peromyscus* sp.	520NW490	Unit 2 (12–14 ka)	L	dent.	i1 m1-2
148985	*Peromyscus* sp.	520NW490	Unit 2 (12–14 ka)	L	dent.	m2
148986	*Peromyscus* sp.	520NW490	Unit 2 (12–14 ka)	R	max.	
148987	*Peromyscus* sp.	520NW490	Unit 2 (12–14 ka)	L	dent.	m1 m2
148988	*Peromyscus* sp.	520NW490	Unit 2 (12–14 ka)	L	max.	
148989	*Peromyscus* sp.	520NW490	Unit 2 (12–14 ka)	R	dent.	m1-m3
148990	*Peromyscus* sp.	520NW490	Unit 2 (12–14 ka)	L	max.	
148991	*Peromyscus* sp.	520NW490	Unit 2 (12–14 ka)	R	dent.	m1
148992	*Peromyscus* sp.	520NW490	Unit 2 (12–14 ka)	R	dent.	m2
148993	*Peromyscus* sp.	520NW490	Unit 1 (10–0 ka)	R	dent.	i1 m1-2
148994	*Peromyscus* sp.	520NW490	Unit 1 (10–0 ka)	L	dent.	i1 m1
148995	*Peromyscus* sp.	505NW515	?	R	dent.	i1 m1
148996	*Peromyscus* sp.	500NW515	?	R	dent.	i1 m1-3
148997	*Peromyscus* sp.	505NW515	?	L	dent.	i1 m1m2
148998	*Peromyscus* sp.	520NW490	Unit 1 (10–0 ka)	R	dent.	i1 m1-m3
148999	*Peromyscus* sp.	520NW490	Unit 1 (10–0 ka)	R	dent.	m1-m3
149000	*Peromyscus* sp.	505NW515	?	L	dent.	m2
149001	*Peromyscus* sp.	580NW465	?	L	dent.	i1 m1-m2
149002	*Peromyscus* sp.	520NW490	Unit 2 (12–14 ka)	R	max.	
149003	*Peromyscus* sp.	505NW515	?	L	dent.	i1 m1
149004	*Peromyscus* sp.	580NW465	?	R	dent.	i1 m1

149005	*Peromyscus* sp.	500NW515	?	L	dent.	m1 m2
149006	*Peromyscus* sp.	580NW465	?	R	dent.	m1-m2
149007	*Peromyscus* sp.	505NW520	Unit 1 (10–0 ka)	R	dent.	m1
149008	*Peromyscus* sp.	505NW525	Unit 3 (17–20 ka)	R	dent.	i1 m1
149009	*Peromyscus* sp.	505NW525	Unit 3 (17–20 ka)	R	dent.	i1 m1-m2
149010	*Peromyscus* sp.	500NW515	Unit 6 (>100ka)	L	dent.	m1
149011	*Peromyscus* sp.	500NW515	Unit 6 (>100ka)	L	dent.	m2
149012	*Peromyscus* sp.	505NW520	Unit 3 (17–20 ka)	R	dent.	i1 m2
149013	*Peromyscus* sp.	495NW520	Unit 2 (12–14 ka)	R	dent.	m1 m2
149014	*Peromyscus* sp.	520NW490	Unit 2 (12–14 ka)	L	dent.	m1
149015	*Peromyscus* sp.	520NW490	Unit 2 (12–14 ka)	L	dent.	i1 m1 m3
149016	*Peromyscus* sp.	520NW490	Unit 2 (12–14 ka)	L	dent.	i1 m1
149017	*Peromyscus* sp.	520NW490	Unit 2 (12–14 ka)	L	dent.	m1-m3
149018	*Peromyscus* sp.	520NW490	Unit 2 (12–14 ka)	L	dent.	i1 m2
149019	*Peromyscus* sp.	505NW520	Unit 1 (10–0 ka)	R	max.	
149020	*Peromyscus* sp.	580NW465	?	L	max.	
149021	*Peromyscus* sp.	505NW515	?	R	max.	
149021	*Peromyscus* sp.	505NW515	?	L	max.	
149023	*Peromyscus* sp.	580NW465	?	R	max.	
149024	*Peromyscus* sp.	580NW465	?	R	max.	
149025	*Peromyscus* sp.	520NW490	Unit 2 (12–14 ka)	L	max.	
149026	*Peromyscus* sp.	520NW490	Unit 2 (12–14 ka)	L	max.	
149027	*Peromyscus* sp.	500NW515	?	L	max.	
149028	*Peromyscus* sp.	495NW515	?	R	max.	
149029	*Peromyscus* sp.	500NW515	Unit 6 (>100ka)	R	max.	
149030	*Peromyscus* sp.	520NW490	Unit 3 (17–20 ka)	R	max.	
149031	*Peromyscus* sp.	520NW490	Unit 2 (12–14 ka)	R	max.	
149032	*Peromyscus* sp.	520NW490	Unit 2 (12–14 ka)	L	max.	
149033	*Peromyscus* sp.	520NW490	Unit 2 (12–14 ka)	L	max.	
149034	*Peromyscus* sp.	520NW490	Unit 2 (12–14 ka)	R	max.	
149035	*Peromyscus* sp.	520NW490	Unit 2 (12–14 ka)	L	dent.	edent.
149039	*Peromyscus* sp.	520NW490	Unit 1 (10–0 ka)	R	dent.	i1 m1-m2
149049	*Peromyscus* sp.	520NW490	Unit 2 (12–14 ka)	L	max.	
149050	*Peromyscus* sp.	520NW490	Unit 2 (12–14 ka)	R	max.	
149296	*Peromyscus* sp.	495NW515	Unit 3 (17–20 ka)	L	dent.	i1 m3
149315	*Peromyscus* sp.	510NW485	Unit 2 (12–14 ka)	R	max.	M1-3
149343	*Peromyscus* sp.	no data	no data	R	dent.	m1-m2
149346	*Peromyscus* sp.	505NW505	Unit 6 (>100ka)	L	max.	M2
149349	*Peromyscus* sp.	510N	Unit 6 (>100ka)	L	max.	M1
149352	*Peromyscus* sp.	505N	Unit 6 (>100ka)	R	dent.	i1 m1-m2
149353	*Peromyscus* sp.	505N	Unit 6 (>100ka)	R	max.	M1
149364	*Peromyscus* sp.	505NW485	Unit 2 (12–14 ka)	L	dent.	m2
149371	*Peromyscus* sp.	505NW485	Unit 2 (12–14 ka)	L	dent.	m1
149381	*Peromyscus* sp.	520NW490	Unit 2 (12–14 ka)	R	dent.	i1 m1
26136	*Neotoma cinerea*	525NW485	Unit 3 (17–20 ka)	R	dent.	i1 m1 m2
26204	*Neotoma cinerea*	535NW490	possibly Unit 3	L	dent.	i1 m1
27421	*Neotoma cinerea*	510NW500	Unit 3 (17–20 ka)	L	dent.	m1-2
27864	*Neotoma cinerea*	525NW485	Unit 2 (12–14 ka)	R	m2	
61777	*Neotoma cinerea*	slump	n/a	L	dent.	i1 m1
64604	*Neotoma cinerea*	520NW505	Unit 2 (12–14 ka)	R	max.	

64605	*Neotoma cinerea*	520NW505	Unit 2 (12–14 ka)	L	m2	
64606	*Neotoma cinerea*	520NW505	Unit 2 (12–14 ka)	R	dent.	i1 m1
64607	*Neotoma cinerea*	520NW505	Unit 2 (12–14 ka)	L	max.	
64608	*Neotoma cinerea*	520NW505	Unit 2 (12–14 ka)	R	dent.	i1 m1
64609	*Neotoma cinerea*	520NW505	Unit 2 (12–14 ka)	R	dent.	i1 m1 m2
64626	*Neotoma cinerea*	520NW505	Unit 2 (12–14 ka)	L	max.	
64672	*Neotoma cinerea*	520NW505	Unit 2 (12–14 ka)	R	dent.	i1 m1 m2
64674	*Neotoma cinerea*	520NW505	Unit 2 (12–14 ka)	L	dent.	i1 m1-2
64675	*Neotoma cinerea*	520NW505	Unit 2 (12–14 ka)	L	dent.	i1 m1
64676	*Neotoma cinerea*	520NW505	Unit 2 (12–14 ka)	R	dent.	i1 m1 m2
64685	*Neotoma cinerea*	525NW485	Unit 1 (10–0 ka)	R	dent.	i1 m1 m3
64689	*Neotoma cinerea*	520NW485	Unit 4 (20–24 ka)	L	dent.	i1 m1
64691	*Neotoma cinerea*	480NW515	possibly Unit 1	L	dent.	i1 m1
64692	*Neotoma cinerea*	480NW515	possibly Unit 1	R	dent.	i1 m1 m2
64694	*Neotoma cinerea*	580NW465	possibly Unit 1	R	max.	
64696	*Neotoma cinerea*	580NW465	possibly Unit 1	R	dent.	i1 m1
64698	*Neotoma cinerea*	580NW465	possibly Unit 1	L & R	max.	RM1-3, LM1-2
64699	*Neotoma cinerea*	580NW465	possibly Unit 1	?	skull	LRM1s
64717	*Neotoma cinerea*	screened mat.	n/a	L & R	max.	
64718	*Neotoma cinerea*	?	n/a	L	max.	
64731	*Neotoma cinerea*	Lions square	Unit 3 (17–20 ka)	R	dent.	m2
64738	*Neotoma cinerea*	517NW515	Unit 1 (10–0 ka)	?	skull	RM1,LM1-2
64741	*Neotoma cinerea*	500NW450	Unit 1 (10–0 ka)	L	max.	
64754	*Neotoma cinerea*	500NW450	Unit 1 (10–0 ka)	L	max.	
64758	*Neotoma cinerea*	520NW495	Unit 1 (10–0 ka)	R	dent.	i1 m2
64759	*Neotoma cinerea*	520NW495	Unit 1 (10–0 ka)	R	dent.	m1-2
64769	*Neotoma cinerea*	520NW505	Unit 2 (12–14 ka)	R	dent.	i1 m2
64772	*Neotoma cinerea*	520NW505	Unit 2 (12–14 ka)	R	M1	
64774	*Neotoma cinerea*	520NW505	Unit 2 (12–14 ka)	R	dent.	i1 m1-3
64777	*Neotoma cinerea*	520NW505	Unit 2 (12–14 ka)	R	max.	
64785	*Neotoma cinerea*	510NW500	possibly Unit 1	R	M1	
64790	*Neotoma cinerea*	520NW490	Unit 2 (12–14 ka)	L	max.	
64801	*Neotoma cinerea*	no data	n/a	R	dent.	i1 m1-2
64808	*Neotoma cinerea*	515NW485	Unit 1 (10–0 ka)	L	dent.	i1 m1
64811	*Neotoma cinerea*	520NW500	Unit 2 (12–14 ka)	R	dent.	i1 m1
64814	*Neotoma cinerea*	520NW500	Unit 2 (12–14 ka)	R	dent.	i1, m1-2
67127	*Neotoma cinerea*	505NW485	Unit 2 (12–14 ka)	L	dent.	i1 m2
67128	*Neotoma cinerea*	505NW485	Unit 2 (12–14 ka)	L	max.	
67130	*Neotoma cinerea*	505NW485	Unit 2 (12–14 ka)	R	M1	
67158	*Neotoma cinerea*	no data	n/a	L	dent.	i1 m1-2
67189	*Neotoma cinerea*	520NW490	Unit 1 (10–0 ka)	L	max.	
67905	*Neotoma cinerea*	505NW485	Unit 2 (12–14 ka)	R	dent.	i1 m1-m3
67920	*Neotoma cinerea*	505NW485	Unit 1 (10–0 ka)	L	dent.	i1 m1
67930	*Neotoma cinerea*	510NW500	possibly Unit 1	L	dent.	i1, m2-3
67986	*Neotoma cinerea*	580NW465	possibly Unit 3	?	skull	LM1
67987	*Neotoma cinerea*	580NW465	possibly Unit 3	R	dent.	m2
68220	*Neotoma cinerea*	580NW465	possibly Unit 2	L	max.	L I1 M1
68233	*Neotoma cinerea*	525NW485	Unit 1 (10–0 ka)	R	dent.	i1 m2-m3
68234	*Neotoma cinerea*	525NW485	Unit 1 (10–0 ka)	R	max.	
68586	*Neotoma cinerea*	510NW485	possibly Unit 1	R	dent.	m2-m3

97236	*Neotoma cinerea*	515NW485	possibly Unit 1	R	m1	
97421	*Neotoma cinerea*	slump	n/a	L	M1	
97852	*Neotoma cinerea*	520NW500	Unit 2 (12–14 ka)	L	m2	
98109	*Neotoma cinerea*	520NW505	Unit 1 (10–0 ka)	R	m2	
124845	*Neotoma cinerea*	505NW510	Unit 1 or 2	R	max.	
125265	*Neotoma cinerea*	500NW510	Unit 3 (17–20 ka)	L	dent.	i1 m1-3
147113	*Neotoma cinerea*	520NW495	Unit 2 (12–14 ka)	?	skull	LRM1s
147114	*Neotoma cinerea*	520NW495	Unit 2 (12–14 ka)	L & R	max.	complete
147118	*Neotoma cinerea*	510NW505	Unit 6 (>100 ka)	R	dent.	i1 m1
147119	*Neotoma cinerea*	495-500NW515	Unit 6 (>100 ka)	L	dent.	m1 m2
147123	*Neotoma cinerea*	500NW450	Unit 1 (10–0 ka)	R	max.	
147126	*Neotoma cinerea*	540NW510	Unit 1 or 2	L	dent.	
147127	*Neotoma cinerea*	540NW510	Unit 1 or 2	R	m2	
147128	*Neotoma cinerea*	515NW485	Unit 1 (10–0 ka)	L	dent.	
147135	*Neotoma cinerea*	510NW505	possibly Unit 6	R	m1	
147136	*Neotoma cinerea*	510NW505	possibly Unit 6	L	m1	
147138	*Neotoma cinerea*	510NW505	possibly Unit 6	R	m2	
147140	*Neotoma cinerea*	510NW505	possibly Unit 6	L	m2	
147142	*Neotoma cinerea*	?	Unit 6 (>100 ka)	L	dent.	
147143	*Neotoma cinerea*	510NW505	Unit 6 (>100 ka)	L	m2	
147144	*Neotoma cinerea*	510NW505	possibly Unit 6	R	max.	
147146	*Neotoma cinerea*	510NW505	possibly Unit 6	R	m1	
147147	*Neotoma cinerea*	580NW465	possibly Unit 3	L	max.	
147150	*Neotoma cinerea*	510NW505	Unit 6 (>100 ka)	L	M1	
147151	*Neotoma cinerea*	510NW505	Unit 6 (>100 ka)	R	m1	
147152	*Neotoma cinerea*	510NW505	possibly Unit 6	R	m1	
147153	*Neotoma cinerea*	510NW505	possibly Unit 6	R	dent.	i1 m1-2
147154	*Neotoma cinerea*	510NW505	possibly Unit 6	R	m1	
147156	*Neotoma cinerea*	500NW450	Unit 1 (10–0 ka)	R	dent.	i1 m1
147158	*Neotoma cinerea*	500NW450	Unit 1 (10–0 ka)	L	dent.	i1 m1
147159	*Neotoma cinerea*	500NW450	Unit 1 (10–0 ka)	L	M1	
147160	*Neotoma cinerea*	505NW485	Unit 2 (12–14 ka)	R	dent.	i1 m2
147161	*Neotoma cinerea*	520NW490	Unit 1 (10–0 ka)	R	M1	
147163	*Neotoma cinerea*	slump	n/a	L	M1	
147164	*Neotoma cinerea*	515NW485	Unit 3 (17–20 ka)	L	dent.	m1 m2
147165	*Neotoma cinerea*	515NW485	Unit 3 (17–20 ka)	L	m1	
147166	*Neotoma cinerea*	515NW485	Unit 3 (17–20 ka)	L	m2	
147167	*Neotoma cinerea*	520NW510	Unit 2 (12–14 ka)	R	max.	
147168	*Neotoma cinerea*	520NW510	Unit 2 (12–14 ka)	L	max.	
147173	*Neotoma cinerea*	520NW505	Unit 2 (12–14 ka)	L	m1	
147174	*Neotoma cinerea*	520NW505	Unit 2 (12–14 ka)	L	m1	
147176	*Neotoma cinerea*	520NW505	Unit 2 (12–14 ka)	R	m1	
147178	*Neotoma cinerea*	525NW485	Unit 1 (10–0 ka)	R	m1	
147182	*Neotoma cinerea*	520NW505	Unit 2 (12–14 ka)	R	m1	
147183	*Neotoma cinerea*	trench w/ash	possibly Unit 6	L	m1	
147184	*Neotoma cinerea*	trench w/ash	possibly Unit 6	L	m2	
147185	*Neotoma cinerea*	screened mat.	n/a	L	m1	
147186	*Neotoma cinerea*	500NW450	Unit 1 (10–0 ka)	R	max.	
147187	*Neotoma cinerea*	500NW515	Unit 1 or 2	L	dent.	i1 m2-3
147189	*Neotoma cinerea*	515NW485	Unit 3 (17–20 ka)		m3	

147190	*Neotoma cinerea*	510NW500	possibly Unit 2	L	M1	
147191	*Neotoma cinerea*	510NW500	possibly Unit 2	R	m1	
147194	*Neotoma cinerea*	500NW515	Unit 1 or 2	L	dent.	i1 m1
147196	*Neotoma cinerea*	520NW505	Unit 2 (12–14 ka)	R	max.	
147197	*Neotoma cinerea*	525NW485	Unit 1 (10–0 ka)	L	m1&m2	
147199	*Neotoma cinerea*	500NW515	Unit 5 (24–100 ka)	L	M1	
147220	*Neotoma cinerea*	520NW505	Unit 1 (10–0 ka)	L	m1	
147221	*Neotoma cinerea*	535NW490	possibly Unit 6	R	max.	m1 m3
147221	*Neotoma cinerea*	535NW490	possibly Unit 6	R	max.	
147222	*Neotoma cinerea*	580NW465	possibly Unit 3	R	M1	
147226	*Neotoma cinerea*	540NW510	Unit 1 or 2	L	dent.	i1 m2-3
147228	*Neotoma cinerea*	515NW485	Unit 1 (10–0 ka)	L	dent.	i1 m1
147235	*Neotoma cinerea*	510NW505	possibly Unit 6	R	m1	
147236	*Neotoma cinerea*	510NW505	possibly Unit 6	L	m1	
147238	*Neotoma cinerea*	510NW505	possibly Unit 6	R	m2	
147240	*Neotoma cinerea*	510NW505	possibly Unit 6	L	m2	
147242	*Neotoma cinerea*	?	Unit 6 (>100 ka)	L	dent.	i1 m1-2
147243	*Neotoma cinerea*	510NW505	Unit 6 (>100 ka)	L	m2	
147244	*Neotoma cinerea*	510NW505	possibly Unit 6	R	max.	M1
147502	*Neotoma cinerea*	515NW485	Unit 2 (12–14 ka)	R	m1	
147503	*Neotoma cinerea*	525NW485	Unit 1 (10–0 ka)	L	max.	
147504	*Neotoma cinerea*	505NW485	Unit 2 (12–14 ka)	L	m1	
147505	*Neotoma cinerea*	520NW490	Unit 2 (12–14 ka)	L	max.	
147506	*Neotoma cinerea*	520NW490	Unit 2 (12–14 ka)	R	dent.	i1 m1-2
147507	*Neotoma cinerea*	520NW490	Unit 2 (12–14 ka)	R	M1	
147508	*Neotoma cinerea*	505NW485	Unit 2 (12–14 ka)	R	max.	I1,M1
147509	*Neotoma cinerea*	495-500NW515	Unit 6 (>100 ka)	L	dent.	i1 m1-3
147510	*Neotoma cinerea*	?	Unit 6 (>100 ka)	L	M1	
147511	*Neotoma cinerea*	?	Unit 6 (>100 ka)	R	dent.	m2
147512	*Neotoma cinerea*	?	Unit 6 (>100 ka)	R	max.	
147513	*Neotoma cinerea*	?	Unit 6 (>100 ka)	L	dent.	m2-m3
147514	*Neotoma cinerea*	?	Unit 6 (>100 ka)	R	dent.	m1
147515	*Neotoma cinerea*	?	Unit 6 (>100 ka)	R	m1	
147516	*Neotoma cinerea*	?	Unit 6 (>100 ka)	L	max.	
147517	*Neotoma cinerea*	500NW505	Unit 6 (>100 ka)	L	M1	
147518	*Neotoma cinerea*	505N	Unit 6 (>100 ka)	R	M1	
147519	*Neotoma cinerea*	505N	Unit 6 (>100 ka)	L	M1	
147520	*Neotoma cinerea*	?	Unit 6 (>100 ka)	L	M1	
147521	*Neotoma cinerea*	495-500NW515	Unit 6 (>100 ka)	R	max.	
147522	*Neotoma cinerea*	505NW505	Unit 6 (>100 ka)	L	M1	
147523	*Neotoma cinerea*	500NW505	possibly Unit 6	L	M1	
147524	*Neotoma cinerea*	510NW505	possibly Unit 6	R	dent.	m1-m3
147528	*Neotoma cinerea*	510NW505	Unit 6 (>100 ka)	R	dent.	m2-3
147529	*Neotoma cinerea*	505NW505	possibly Unit 6	R	max.	
147530	*Neotoma cinerea*	505NW505	Unit 6 (>100 ka)	R	m1	
147531	*Neotoma cinerea*	505NW505	possibly Unit 6	R	m1	
147532	*Neotoma cinerea*	500NW505	possibly Unit 6	L	M1	
147533	*Neotoma cinerea*	510N	Unit 6 (>100 ka)	L	m1	
147534	*Neotoma cinerea*	510NW505	Unit 6 (>100 ka)	L	M3	
147535	*Neotoma cinerea*	505NW505	possibly Unit 6	L	m2	

147536	*Neotoma cinerea*	505NW505	possibly Unit 6	R	M1	
147538	*Neotoma cinerea*	510NW505	Unit 6 (>100 ka)	L	M1	
147542	*Neotoma cinerea*	510NW505	Unit 6 (>100 ka)	L	m2	
147544	*Neotoma cinerea*	505NW505	possibly Unit 6	R	m1	
147545	*Neotoma cinerea*	510NW505	Unit 6 (>100 ka)	R	M1	
147548	*Neotoma cinerea*	510NW505	Unit 6 (>100 ka)	L	M1	
147549	*Neotoma cinerea*	510NW505	Unit 6 (>100 ka)	L	M1	
147550	*Neotoma cinerea*	510N	Unit 6 (>100 ka)	R	m1	
147551	*Neotoma cinerea*	510NW505	Unit 6 (>100 ka)	L	dent.	m1
147557	*Neotoma cinerea*	510NW505	Unit 6 (>100 ka)	L	m1	
147558	*Neotoma cinerea*	510N	Unit 6 (>100 ka)	R	m1	
147559	*Neotoma cinerea*	510N	Unit 6 (>100 ka)	L	m2	
147561	*Neotoma cinerea*	510N	Unit 6 (>100 ka)	R	m1	
147565	*Neotoma cinerea*	500NW505	possibly Unit 6	R	m2	
147568	*Neotoma cinerea*	500NW505	possibly Unit 6	R	M1	
147569	*Neotoma cinerea*	500NW505	possibly Unit 6	R	m1	
147575	*Neotoma cinerea*	495-500NW515	Unit 6 (>100 ka)	R	m1	
147576	*Neotoma cinerea*	495-500NW515	Unit 6 (>100 ka)	L	m2	
147577	*Neotoma cinerea*	495-500NW515	Unit 6 (>100 ka)	L	m2	
147578	*Neotoma cinerea*	495-500NW515	Unit 6 (>100 ka)	R	m2	
147580	*Neotoma cinerea*	495-500NW515	Unit 6 (>100 ka)	L	m1	
147582	*Neotoma cinerea*	495-500NW515	Unit 6 (>100 ka)	L	m2	
147584	*Neotoma cinerea*	495-500NW515	Unit 6 (>100 ka)	L	m2	
147587	*Neotoma cinerea*	510NW505	Unit 6 (>100 ka)	R	m2	
147590	*Neotoma cinerea*	510NW505	Unit 6 (>100 ka)	L	m1	
147591	*Neotoma cinerea*	510NW505	Unit 6 (>100 ka)	R	m1	
147594	*Neotoma cinerea*	510NW505	Unit 6 (>100 ka)	R	m1	
147595	*Neotoma cinerea*	510NW505	Unit 6 (>100 ka)	L	m1	
147598	*Neotoma cinerea*	505NW505	Unit 6 (>100 ka)	L	m1	
147600	*Neotoma cinerea*	505NW505	Unit 6 (>100 ka)	R	m2	
147601	*Neotoma cinerea*	505NW505	Unit 6 (>100 ka)	R	m2	
147602	*Neotoma cinerea*	505NW505	Unit 6 (>100 ka)	R	m1	
147603	*Neotoma cinerea*	505NW505	Unit 6 (>100 ka)	R	m2	
147608	*Neotoma cinerea*	?	Unit 6 (>100 ka)	R	m1	
147609	*Neotoma cinerea*	?	Unit 6 (>100 ka)	L	m2	
147610	*Neotoma cinerea*	?	Unit 6 (>100 ka)	R	m1	
147611	*Neotoma cinerea*	?	Unit 6 (>100 ka)	R	m1	
147614	*Neotoma cinerea*	495-500NW515	Unit 6 (>100 ka)	L	dent.	m1-m2
147617	*Neotoma cinerea*	505NW505	Unit 6 (>100 ka)	R	m2	
147618	*Neotoma cinerea*	505N	Unit 6 (>100 ka)	L	m1	
147619	*Neotoma cinerea*	505N	Unit 6 (>100 ka)	R	m2	
147620	*Neotoma cinerea*	505N	Unit 6 (>100 ka)	L	M1	
147621	*Neotoma cinerea*	505N	Unit 6 (>100 ka)	R	m1	
147622	*Neotoma cinerea*	505N	Unit 6 (>100 ka)	L	m2	
147623	*Neotoma cinerea*	510NW505	Unit 6 (>100 ka)	L	m1	
147626	*Neotoma cinerea*	500NW505	Unit 6 (>100 ka)	L	m1	
147627	*Neotoma cinerea*	500NW505	Unit 6 (>100 ka)	R	m1	
147631	*Neotoma cinerea*	505NW505	possibly Unit 6	L	M1	
147632	*Neotoma cinerea*	510N	Unit 6 (>100 ka)	R	M1	
147633	*Neotoma cinerea*	510NW505	Unit 6 (>100 ka)	R	max.	

147634	*Neotoma cinerea*	510NW505	Unit 6 (>100 ka)	L	max.	
147635	*Neotoma cinerea*	510NW505	Unit 6 (>100 ka)	L	M1	
147636	*Neotoma cinerea*	500NW505	Unit 6 (>100 ka)	R	max.	
147654	*Neotoma cinerea*	485-490NW515	Unit 4 (210–00 ka)	R	max.	M1
147655	*Neotoma cinerea*	485-490NW515	Unit 4 (210–00 ka)	R	dent.	i1, m2
147666	*Neotoma cinerea*	505NW485	Unit 2 (12–14 ka)	R	max.	
147919	*Neotoma cinerea*	495-500NW515	Unit 6 (>100 ka)	L	dent.	m1
148227	*Neotoma cinerea*	505NW485	Unit 2 (12–14 ka)	R	m1	
148228	*Neotoma cinerea*	505NW485	Unit 2 (12–14 ka)	R	m1	
148229	*Neotoma cinerea*	505NW485	Unit 2 (12–14 ka)	L	m1	
148230	*Neotoma cinerea*	505NW485	Unit 2 (12–14 ka)	L	m1	
148231	*Neotoma cinerea*	505NW485	Unit 2 (12–14 ka)	L	M1	
148232	*Neotoma cinerea*	505NW485	Unit 2 (12–14 ka)	L	M1	
148241	*Neotoma cinerea*	505NW485	Unit 2 (12–14 ka)	L	m1	
148257	*Neotoma cinerea*	505NW485	Unit 2 (12–14 ka)	L	M1	
148271	*Neotoma cinerea*	520NW510	Unit 1 (10–0 ka)	R	m1	
148301	*Neotoma cinerea*	485NW500	n/a	L	m2	
148315	*Neotoma cinerea*	480NW515	possibly Unit 1	L	m1	
148323	*Neotoma cinerea*	520NW520	Unit 3 (17–20 ka)	R	M1	
148344	*Neotoma cinerea*	510NW485	Unit 2 (12–14 ka)	L	M1	
148345	*Neotoma cinerea*	510NW485	Unit 2 (12–14 ka)	L	m1	
148368	*Neotoma cinerea*	495NW515	Unit 1 or 2	?	skull	LR I1,LM1-M2
148383	*Neotoma cinerea*	485NW505	Unit 1 (10–0 ka)	R	max.	M1
148384	*Neotoma cinerea*	485NW505	Unit 1 (10–0 ka)	L	dent.	m1
148385	*Neotoma cinerea*	485NW505	Unit 1 (10–0 ka)	R	m1	
148386	*Neotoma cinerea*	485NW505	Unit 1 (10–0 ka)	L	m1	
148406	*Neotoma cinerea*	510NW505	Unit 6 (>100 ka)	R	m2	
148407	*Neotoma cinerea*	510NW506	Unit 6 (>100 ka)	R	m2	
148467	*Neotoma cinerea*	520NW500	Unit 2 (12–14 ka)	L	m1	
148577	*Neotoma cinerea*	495NW515	Unit 3 (17–20 ka)	R	m2	
148578	*Neotoma cinerea*	495NW515	Unit 3 (17–20 ka)	L	m2	
148579	*Neotoma cinerea*	510NW515B	Unit 5 (24–100 ka)	R	M1	
148585	*Neotoma cinerea*	510NW515B	Unit 5 (24–100 ka)	R	M1	
148586	*Neotoma cinerea*	510NW515B	Unit 5 (24–100 ka)	L	M1	
148589	*Neotoma cinerea*	510NW515B	Unit 5 (24–100 ka)	L	m2	
148592	*Neotoma cinerea*	510NW515B	Unit 5 (24–100 ka)	R	M1	
148593	*Neotoma cinerea*	495NW515	Unit 3 (17–20 ka)	L	m1	
148594	*Neotoma cinerea*	510NW515B	Unit 5 (24–100 ka)	R	M1	
148596	*Neotoma cinerea*	495NW515	Unit 3 (17–20 ka)	L	M1	
148597	*Neotoma cinerea*	495NW515	Unit 3 (17–20 ka)	L	m2	
148604	*Neotoma cinerea*	500NW515	Unit 3 (17–20 ka)	R	M1	
148606	*Neotoma cinerea*	495NW515	Unit 1 or 2	R	M1	
148611	*Neotoma cinerea*	505NW520	Unit 3 (17–20 ka)	L	m1	
148612	*Neotoma cinerea*	520NW510	Unit 2 (12–14 ka)	R	M1	
148614	*Neotoma cinerea*	505NW530	possibly Unit 3	L	m1	
148618	*Neotoma cinerea*	495NW515	Unit 1 or 2	L	m2	
148619	*Neotoma cinerea*	495NW515	Unit 1 or 2	R	m1	
148620	*Neotoma cinerea*	495NW515	Unit 1 or 2	L	m1	
148621	*Neotoma cinerea*	495NW515	Unit 1 or 2	L	m1	
148622	*Neotoma cinerea*	495NW515	Unit 1 or 2	R	M1	

148624	*Neotoma cinerea*	495NW515	Unit 1 or 2	R	m2	
148625	*Neotoma cinerea*	495NW515	Unit 1 or 2	R	M1	
148626	*Neotoma cinerea*	500NW515	Unit 3 (17–20 ka)	R	m2	
148627	*Neotoma cinerea*	520NW510	Unit 2 (12–14 ka)	L	M1	
148641	*Neotoma cinerea*	520NW510	Unit 2 (12–14 ka)	L	m1	
148642	*Neotoma cinerea*	505NW525	Unit 3 (17–20 ka)	L	M1	
148649	*Neotoma cinerea*	515NW520	Unit 3 (17–20 ka)	R	M1	
148653	*Neotoma cinerea*	500NW520	Unit 3 (17–20 ka)	L	m2	
148654	*Neotoma cinerea*	500NW520	Unit 3 (17–20 ka)	L	m1	
148668	*Neotoma cinerea*	505NW515	Unit 1 or 2	R	m2	
148669	*Neotoma cinerea*	505NW515	Unit 1 or 2	L	m1	
148679	*Neotoma cinerea*	505NW515	Unit 1 or 2	L	m1	
148680	*Neotoma cinerea*	520NW490	Unit 2 (12–14 ka)	L	m2	
148685	*Neotoma cinerea*	520NW490	Unit 2 (12–14 ka)	L	m1	
148691	*Neotoma cinerea*	520NW490	Unit 2 (12–14 ka)	L	M1	
148693	*Neotoma cinerea*	520NW490	Unit 2 (12–14 ka)	R	m2	
148696	*Neotoma cinerea*	520NW490	Unit 2 (12–14 ka)	R	m2	
148697	*Neotoma cinerea*	520NW490	Unit 2 (12–14 ka)	L	M1	
148698	*Neotoma cinerea*	520NW490	Unit 2 (12–14 ka)	R	m2	
148699	*Neotoma cinerea*	520NW490	Unit 2 (12–14 ka)	R	m1	
148707	*Neotoma cinerea*	520NW490	Unit 2 (12–14 ka)	R	m1	
148710	*Neotoma cinerea*	505NW520	Unit 3 (17–20 ka)	L	m2	
148711	*Neotoma cinerea*	500NW520	Unit 2 (12–14 ka)	R	M1	
148716	*Neotoma cinerea*	500NW520	Unit 3 (17–20 ka)	R	M1	
148717	*Neotoma cinerea*	505NW515	Unit 1 or 2	R	m1	
148718	*Neotoma cinerea*	500NW515	Unit 3 (17–20 ka)	R	m1	
148720	*Neotoma cinerea*	505NW520	Unit 3 (17–20 ka)	L	M1	
148721	*Neotoma cinerea*	505NW515	Unit 1 or 2	R	m1	
148727	*Neotoma cinerea*	505NW515	Unit 1 or 2	L	m1	
148729	*Neotoma cinerea*	505NW520	Unit 1 (10–0 ka)	R	m1	
148730	*Neotoma cinerea*	500NW515	Unit 6 (>100 ka)	L	m1	
148733	*Neotoma cinerea*	505NW520	Unit 3 (17–20 ka)	L	m1	
148734	*Neotoma cinerea*	520NW490	Unit 3 (17–20 ka)	R	M1	
148735	*Neotoma cinerea*	500NW515	Unit 1 or 2	R	m1	
148736	*Neotoma cinerea*	520NW510	Unit 1 (10–0 ka)	L	m2	
148739	*Neotoma cinerea*	505NW515	Unit 1 or 2	R	M1	
148742	*Neotoma cinerea*	500NW515	Unit 6 (>100 ka)	L	m2	
148745	*Neotoma cinerea*	520NW525	Unit 1 (10–0 ka)	R	M1	
148746	*Neotoma cinerea*	500NW515	Unit 3 (17–20 ka)	L	m1	
148747	*Neotoma cinerea*	505NW515	Unit 1 or 2	R	m1	
148754	*Neotoma cinerea*	580NW465	possibly Unit 3	R	dent.	i1 m2
148900	*Neotoma cinerea*	500NW515	possibly Unit 4	R	m1	
148904	*Neotoma cinerea*	500NW515	possibly Unit 4	L	m1	
148906	*Neotoma cinerea*	500NW515	possibly Unit 4	R	m1	
148908	*Neotoma cinerea*	500NW515	possibly Unit 4	R	m2	
149295	*Neotoma cinerea*	517NW515	Unit 1 (10–0 ka)	L	m1	
149326	*Neotoma cinerea*	505NW505	Unit 6 (>100 ka)	R	max.	M1
149335	*Neotoma cinerea*	500NW505	possibly Unit 6	R	m2	
149340	*Neotoma cinerea*	?	Unit 6 (>100 ka)	L	m1	
149342	*Neotoma cinerea*	no data	no data	R	m2	

149360	*Neotoma cinerea*	510NW505	possibly Unit 6	L	dent.	i1, m2
149361	*Neotoma cinerea*	510NW505	possibly Unit 6	L	dent.	m1
64610	*Neotoma* sp.	520NW505	Unit 2 (12–14 ka)	L	dent.	i1
64652	*Neotoma* sp.	500NW500	possibly Unit 3	L	dent.	i1
64713	*Neotoma* sp.	General Collection	n/a	L	dent.	i1 m2
64716	*Neotoma* sp.	screened mat	n/a	L	dent.	i1 m3
64719	*Neotoma* sp.	screened mat	n/a	L	dent.	i1 m2
64738	*Neotoma* sp.	517NW515	Unit 1 (10–0 ka)	?	skull	LR I1,M1 R M2
64778	*Neotoma* sp.	520NW505	Unit 2 (12–14 ka)	L	dent.	i1 m2 m3
64815	*Neotoma* sp.	480NW500	possibly Unit 1	R	dent.	i1 m3
67129	*Neotoma* sp.	525NW485	Unit 2 (12–14 ka)	L	max.	edent.
67976	*Neotoma* sp.	?	n/a	R	m2	
68752	*Neotoma* sp.	510nw485	possibly Unit 1	?	skull	edent.
97801	*Neotoma* sp.	517NW515	Unit 2 (12–14 ka)	R	dent.	i1
97813	*Neotoma* sp.	520NW510	Unit 1 (10–0 ka)	R	dent.	i1
97813	*Neotoma* sp.	520NW510	Unit 1 (10–0 ka)	R	dent.	i1
97819	*Neotoma* sp.	515NW485	Unit 2 (12–14 ka)	R	dent.	i1
97843	*Neotoma* sp.	520NW500	Unit 2 (12–14 ka)	R	dent.	i1
97846	*Neotoma* sp.	517NW515	Unit 1 (10–0 ka)	L	dent.	i1
97849	*Neotoma* sp.	520NW500	Unit 2 (12–14 ka)	L	dent.	i1
97857	*Neotoma* sp.	515NW485	Unit 1 (10–0 ka)	R & L	dent.& R max.	LR i1
98101	*Neotoma* sp.	520NW505	Unit 1 (10–0 ka)	R	M2	
98104	*Neotoma* sp.	520NW505	Unit 1 (10–0 ka)	L	dent.	i1
124822	*Neotoma* sp.	505NW510	Unit 1 or 2	R	dent.	i1
124823	*Neotoma* sp.	505NW510	Unit 1 or 2	R	dent.	i1
124824	*Neotoma* sp.	505NW510	Unit 1 or 2	R	dent.	edent.
124846	*Neotoma* sp.	505NW510	Unit 1 or 2	L	dent.	i1
125062	*Neotoma* sp.	505NW510	Unit 1 or 2	L	dent.	edent.
126816	*Neotoma* sp.	no data	n/a	?	skull	edent.
126822	*Neotoma* sp.	505NW485	Unit 2 (12–14 ka)	L	max. & premax.	M3
127001	*Neotoma* sp.	500NW450	Unit 1 (10–0 ka)	L	max.	edent.
127002	*Neotoma* sp.	580NW465	possibly Unit 1	R	dent.	m3
127003	*Neotoma* sp.	500NW450	Unit 1 (10–0 ka)	R	dent.	i1
127004	*Neotoma* sp.	540NW510	Unit 1 or 2	R	dent.	edent.
127095	*Neotoma* sp.	505NW485	Unit 2 (12–14 ka)	R	max.	edent.
127096	*Neotoma* sp.	505NW485	Unit 2 (12–14 ka)	L	dent.	i1
147115	*Neotoma* sp.	520NW495	Unit 2 (12–14 ka)	R	dent.	i1
147116	*Neotoma* sp.	520NW495	Unit 2 (12–14 ka)	R	dent.	i1
147117	*Neotoma* sp.	520NW505	Unit 2 (12–14 ka)	R	m2	
147124	*Neotoma* sp.	540NW510	Unit 1 or 2	R	dent.	
147125	*Neotoma* sp.	540NW510	Unit 1 or 2	L	dent.	
147129	*Neotoma* sp.	580NW465	possibly Unit 1	?	skull	
147130	*Neotoma* sp.	510NW505	possibly Unit 6	L	M3	
147131	*Neotoma* sp.	510NW505	possibly Unit 6	?	m	fragment
147132	*Neotoma* sp.	510NW505	possibly Unit 6	L	m2	
147133	*Neotoma* sp.	510NW505	possibly Unit 6	L	M2	
147134	*Neotoma* sp.	510NW505	possibly Unit 6	R	M2	
147137	*Neotoma* sp.	510NW505	possibly Unit 6	R	M2	

147139	*Neotoma* sp.	510NW505	possibly Unit 6	R	m2	
147141	*Neotoma* sp.	510NW505	possibly Unit 6	L	m2	
147145	*Neotoma* sp.	510NW505	Unit 6 (>100 ka)	R	M2	
147148	*Neotoma* sp.	510NW505	possibly Unit 6	L	m2	
147149	*Neotoma* sp.	510NW505	possibly Unit 6		m3	
147155	*Neotoma* sp.	510NW505	possibly Unit 6	L	m2	
147157	*Neotoma* sp.	500NW450	Unit 1 (10–0 ka)	L	dent.	i1 m2
147162	*Neotoma* sp.	slump	n/a	L	M2	
147169	*Neotoma* sp.	520NW510	Unit 2 (12–14 ka)	L	M2	
147171	*Neotoma* sp.	slump	n/a	?	m3	
147172	*Neotoma* sp.	520NW505	Unit 2 (12–14 ka)	R	m2	
147175	*Neotoma* sp.	520NW505	Unit 2 (12–14 ka)	L	m2	
147177	*Neotoma* sp.	515NW485	Unit 1 (10–0 ka)	?	m3	
147179	*Neotoma* sp.	525NW485	Unit 1 (10–0 ka)	L	M3	
147180	*Neotoma* sp.	525NW485	Unit 1 (10–0 ka)	L	M2	
147181	*Neotoma* sp.	525NW485	Unit 1 (10–0 ka)	L	M2	
147188	*Neotoma* sp.	Wall clean up	Unit 3 (17–20 ka)	R	max.	M3
147192	*Neotoma* sp.	510NW500	possibly Unit 2	L	M2	
147193	*Neotoma* sp.	510NW500	possibly Unit 2	L	m2	
147195	*Neotoma* sp.	485-490NW515	Unit 4 (210–00 ka)	R	M2	
147198	*Neotoma* sp.	520NW505	Unit 2 (12–14 ka)	R	dent.	m3
147200	*Neotoma* sp.	500NW515	Unit 4 (210–00 ka)	L	M2	
147224	*Neotoma* sp.	540NW510	Unit 1 or 2	R	dent.	i1 m2-m3
147225	*Neotoma* sp.	540NW510	Unit 1 or 2	L	dent.	i1 m1
147229	*Neotoma* sp.	580NW465	possibly Unit 1	?	skull	edent.
147230	*Neotoma* sp.	510NW505	possibly Unit 6	L	M3	
147231	*Neotoma* sp.	510NW505	possibly Unit 6	?	molar	
147232	*Neotoma* sp.	510NW505	possibly Unit 6	L	m2	
147233	*Neotoma* sp.	510NW505	possibly Unit 6	L	M2	
147234	*Neotoma* sp.	510NW505	possibly Unit 6	R	M2	
147237	*Neotoma* sp.	510NW505	possibly Unit 6	R	M2	
147239	*Neotoma* sp.	510NW505	possibly Unit 6	R	m2	
147241	*Neotoma* sp.	510NW505	possibly Unit 6	L	m2	
147525	*Neotoma* sp.	505NW505	Unit 6 (>100 ka)	R	max.	M2
147526	*Neotoma* sp.	505NW505	possibly Unit 6	L	max.	M2
147527	*Neotoma* sp.	505NW505	possibly Unit 6	R	dent.	m3
147528	*Neotoma* sp.	510NW505	Unit 6 (>100 ka)	R	dent.	m2 m3
147537	*Neotoma* sp.	505NW505	possibly Unit 6	R	M2	
147539	*Neotoma* sp.	505NW505	possibly Unit 6	L	M3	
147540	*Neotoma* sp.	495-500NW515	n/a	L	M3	
147541	*Neotoma* sp.	505NW505	possibly Unit 6	L	m1	
147543	*Neotoma* sp.	510NW505	Unit 6 (>100 ka)	L	M2-3	
147546	*Neotoma* sp.	510NW505	Unit 6 (>100 ka)	L	m2	
147547	*Neotoma* sp.	510NW505	Unit 6 (>100 ka)	L	M3	
147552	*Neotoma* sp.	505NW505	Unit 6 (>100 ka)	L	M2	
147553	*Neotoma* sp.	505NW505	Unit 6 (>100 ka)	R	M3	
147554	*Neotoma* sp.	505NW505	Unit 6 (>100 ka)	?	m3	
147555	*Neotoma* sp.	505NW505	possibly Unit 6	L	M3	
147556	*Neotoma* sp.	505NW505	possibly Unit 6	L	M3	
147560	*Neotoma* sp.	510N	Unit 6 (>100 ka)	L	m2	

147562	*Neotoma* sp.	510N	Unit 6 (>100 ka)	R	m2	
147563	*Neotoma* sp.	510N	Unit 6 (>100 ka)	?	m3	
147564	*Neotoma* sp.	510N	Unit 6 (>100 ka)	?	m3	
147566	*Neotoma* sp.	500NW505	possibly Unit 6	R	m2	
147567	*Neotoma* sp.	500NW505	possibly Unit 6	L	M2	
147570	*Neotoma* sp.	500NW505	possibly Unit 6	R	M2	
147571	*Neotoma* sp.	500NW505	possibly Unit 6	L	M2	
147572	*Neotoma* sp.	500NW505	possibly Unit 6	?	m3	
147573	*Neotoma* sp.	510NW505	Unit 6 (>100 ka)	L	M3	
147574	*Neotoma* sp.	510NW505	Unit 6 (>100 ka)	R	M3	
147579	*Neotoma* sp.	495-500NW515	n/a		m3	
147581	*Neotoma* sp.	495-500NW515	Unit 6 (>100 ka)	L	M2	
147583	*Neotoma* sp.	495-500NW515	Unit 6 (>100 ka)	R	M2	
147586	*Neotoma* sp.	510NW505	Unit 6 (>100 ka)	L	M2	
147588	*Neotoma* sp.	510NW505	Unit 6 (>100 ka)		m3	
147589	*Neotoma* sp.	510NW505	Unit 6 (>100 ka)	L	M2	
147592	*Neotoma* sp.	510NW505	Unit 6 (>100 ka)	L	M3	
147596	*Neotoma* sp.	510NW505	Unit 6 (>100 ka)	R	M3	
147597	*Neotoma* sp.	505NW505	Unit 6 (>100 ka)	L	M2	
147599	*Neotoma* sp.	505NW505	Unit 6 (>100 ka)	R	M2	
147604	*Neotoma* sp.	505NW505	Unit 6 (>100 ka)	R	M3	
147605	*Neotoma* sp.	505NW505	Unit 6 (>100 ka)	R	M2	
147607	*Neotoma* sp.	?	Unit 6 (>100 ka)	R	m2	
147612	*Neotoma* sp.	?	Unit 6 (>100 ka)	R	M2	
147615	*Neotoma* sp.	505N	Unit 6 (>100 ka)	L	M2	
147624	*Neotoma* sp.	510NW505	Unit 6 (>100 ka)	L	M3	
147625	*Neotoma* sp.	500NW505	Unit 6 (>100 ka)	R	M2	
147628	*Neotoma* sp.	500NW505	Unit 6 (>100 ka)	R	m2	
147629	*Neotoma* sp.	500NW505	Unit 6 (>100 ka)	R	M3	
147630	*Neotoma* sp.	510NW505	possibly Unit 6	R	M2	
147955	*Neotoma* sp.	505NW505	possibly Unit 6	L	M3	
148030	*Neotoma* sp.	495-500NW515	Unit 6 (>100 ka)	R	M2	
148154	*Neotoma* sp.	505NW485	Unit 2 (12–14 ka)	R	dent.	edent.
148155	*Neotoma* sp.	500NW450	Unit 1 (10–0 ka)	L	dent.	i1
148156	*Neotoma* sp.	500NW450	Unit 1 (10–0 ka)	L	dent.	i1
148157	*Neotoma* sp.	500NW450	Unit 1 (10–0 ka)	R	dent.	i1
148158	*Neotoma* sp.	500NW515	n/a	L	dent.	i1
148159	*Neotoma* sp.	525NW485	Unit 1 (10–0 ka)	L	dent.	i1
148160	*Neotoma* sp.	525NW485	Unit 1 (10–0 ka)	R	dent.	i1
148161	*Neotoma* sp.	500NW515	Unit 1 or 2	R	dent.	edent.
148162	*Neotoma* sp.	500NW450	possibly Unit 3	L	dent.	i1
148163	*Neotoma* sp.	no data	n/a	L	max.	edent.
148164	*Neotoma* sp.	520NW490	Unit 1 (10–0 ka)	R	max.	edent.
148165	*Neotoma* sp.	?	n/a	R	max.	edent.
148166	*Neotoma* sp.	505-515N	Unit 3 (17–20 ka)	L	max.	edent.
148167	*Neotoma* sp.	520NW510	Unit 2 (12–14 ka)	L	dent.	i1
148168	*Neotoma* sp.	520NW490	Unit 1 (10–0 ka)	L	dent.	i1
148169	*Neotoma* sp.	screened mat	n/a	R	max.	edent.
148170	*Neotoma* sp.	510NW500	possibly Unit 2	L	max.	edent.
148171	*Neotoma* sp.	525NW485	Unit 1 (10–0 ka)	L	dent.	i1

148172	*Neotoma* sp.	515NW485	Unit 3 (17–20 ka)	L	dent.	i1
148173	*Neotoma* sp.	500NW450	Unit 1 (10–0 ka)	R	max.	edent.
148174	*Neotoma* sp.	500NW450	Unit 1 (10–0 ka)	R	max.	edent.
148175	*Neotoma* sp.	580NW465	possibly Unit 1	R	max.	edent.
148176	*Neotoma* sp.	580NW465	possibly Unit 1	L	max.	edent.
148177	*Neotoma* sp.	500NW510	Unit 1 or 2	L	dent.	i1
148178	*Neotoma* sp.	500NW510	Unit 1 or 2	L	dent.	i1
148179	*Neotoma* sp.	500NW510	Unit 1 or 2	L	dent.	i1
148180	*Neotoma* sp.	500NW510	Unit 1 or 2	R	dent.	i1
148181	*Neotoma* sp.	500NW510	Unit 1 or 2	R	dent.	i1
148182	*Neotoma* sp.	500NW450	possibly Unit 3	L & R	max.	edent.
148183	*Neotoma* sp.	520NW505	Unit 2 (12–14 ka)	L	dent.	i1
148184	*Neotoma* sp.	520NW505	Unit 2 (12–14 ka)	L	dent.	i1
148185	*Neotoma* sp.	520NW505	Unit 2 (12–14 ka)	R	dent.	edent.
148186	*Neotoma* sp.	520NW505	Unit 2 (12–14 ka)	R	dent.	i1
148187	*Neotoma* sp.	wall cleanup	Unit 3 (17–20 ka)	R	dent.	edent.
148188	*Neotoma* sp.	wall cleanup	Unit 3 (17–20 ka)	L	dent.	i1
148189	*Neotoma* sp.	520NW495	Unit 1 (10–0 ka)	R	dent.	edent.
148190	*Neotoma* sp.	520NW495	Unit 1 (10–0 ka)	L	max.	edent.
148192	*Neotoma* sp.		Unit 6 (>100 ka)	L	dent.	edent.
148193	*Neotoma* sp.	520NW505	Unit 2 (12–14 ka)	R	dent.	i1
148194	*Neotoma* sp.		Unit 6 (>100 ka)	L	dent.	edent.
148195	*Neotoma* sp.	500NW505	Unit 6 (>100 ka)	L	dent.	edent.
148217	*Neotoma* sp.	505NW485	Unit 2 (12–14 ka)	L	max.	edent.
148218	*Neotoma* sp.	505NW485	Unit 2 (12–14 ka)	L	dent.	i1
148219	*Neotoma* sp.	505NW485	Unit 2 (12–14 ka)	L	dent.	i1
148220	*Neotoma* sp.	505NW485	Unit 2 (12–14 ka)	L	dent.	i1
148221	*Neotoma* sp.	505NW485	Unit 2 (12–14 ka)	R	dent.	edent.
148222	*Neotoma* sp.	505NW485	Unit 2 (12–14 ka)	R	dent.	i1
148223	*Neotoma* sp.	505NW485	Unit 2 (12–14 ka)	R	dent.	edent.
148224	*Neotoma* sp.	505NW485	Unit 2 (12–14 ka)	R	dent.	i1
148225	*Neotoma* sp.	505NW485	Unit 2 (12–14 ka)	?	skull	LR I1
148233	*Neotoma* sp.	505NW485	Unit 2 (12–14 ka)	?	m3	
148234	*Neotoma* sp.	505NW485	Unit 2 (12–14 ka)	L	m2	
148235	*Neotoma* sp.	505NW485	Unit 2 (12–14 ka)	R	m2	
148236	*Neotoma* sp.	505NW485	Unit 2 (12–14 ka)	R	m2	
148237	*Neotoma* sp.	505NW485	Unit 2 (12–14 ka)	R	m2	
148240	*Neotoma* sp.	505NW485	Unit 2 (12–14 ka)	L	dent.	edent.
148253	*Neotoma* sp.	505NW485	Unit 2 (12–14 ka)	R	dent.	i1
148254	*Neotoma* sp.	505NW485	Unit 2 (12–14 ka)	R	dent.	i1
148255	*Neotoma* sp.	505NW485	Unit 2 (12–14 ka)	L	dent.	i1
148256	*Neotoma* sp.	505NW485	Unit 2 (12–14 ka)	L	dent.	edent.
148286	*Neotoma* sp.	495NW510	Unit 1 or 2	L	dent.	edent.
148293	*Neotoma* sp.	485NW500	n/a	L	dent.	i1
148298	*Neotoma* sp.	580NW465	possibly Unit 1	L	max.	edent.
148299	*Neotoma* sp.	480NW515	possibly Unit 1	L	dent.	i1
148302	*Neotoma* sp.	485NW500	n/a	L	dent.	i1
148303	*Neotoma* sp.	485NW500	n/a	?	m3	
148304	*Neotoma* sp.	520NW505	Unit 1 (10–0 ka)	R	dent.	i1
148314	*Neotoma* sp.	480NW515	Unit 1 (10–0 ka)	R	dent.	edent.

148321	*Neotoma* sp.	520NW520	Unit 3 (17–20 ka)	R	dent.	i1
148322	*Neotoma* sp.	520NW520	Unit 3 (17–20 ka)	R	max.	M2
148346	*Neotoma* sp.	510nw485	Unit 2 (12–14 ka)	L	dent.	i1
148347	*Neotoma* sp.	510nw485	Unit 2 (12–14 ka)	L	dent.	edent.
148358	*Neotoma* sp.	510NW485	Unit 2 (12–14 ka)	R	dent.	i1
148359	*Neotoma* sp.	510NW485	Unit 2 (12–14 ka)	R	dent.	i1
148360	*Neotoma* sp.	510NW485	Unit 2 (12–14 ka)	L	m2	
148361	*Neotoma* sp.	510NW485	Unit 2 (12–14 ka)		m3	
148369	*Neotoma* sp.	495NW515	Unit 1 or 2	R	dent.	edent.
148372	*Neotoma* sp.	510NW485	Unit 2 (12–14 ka)		skull	R I1
148377	*Neotoma* sp.	485NW505	Unit 1 (10–0 ka)	R	dent.	i1
148378	*Neotoma* sp.	485NW505	Unit 1 (10–0 ka)	R	dent.	i1
148379	*Neotoma* sp.	485NW505	Unit 1 (10–0 ka)	L	dent.	i1
148380	*Neotoma* sp.	485NW505	Unit 1 (10–0 ka)	R	max.	edent.
148381	*Neotoma* sp.	485NW505	Unit 1 (10–0 ka)	?	m3	
148382	*Neotoma* sp.	485NW505	Unit 1 (10–0 ka)	R	M2-M3	
148387	*Neotoma* sp.	485NW505	Unit 1 (10–0 ka)	L	dent.	i1
148388	*Neotoma* sp.	485NW505	Unit 1 (10–0 ka)	R	dent.	edent.
148393	*Neotoma* sp.	500NW505	possibly Unit 1	R	dent.	i1
148395	*Neotoma* sp.	?	Unit 6 (>100 ka)	L	max.	edent.
148398	*Neotoma* sp.	510NW505	possibly Unit 6	L	max.	edent.
148399	*Neotoma* sp.	510NW505	possibly Unit 6	R	max.	edent.
148409	*Neotoma* sp.	510NW505	Unit 6 (>100 ka)	R	dent.	edent.
148410	*Neotoma* sp.	515NW485	Unit 2 (12–14 ka)	L	dent.	edent.
148411	*Neotoma* sp.	520NW495	Unit 2 (12–14 ka)	L	dent.	i1
148412	*Neotoma* sp.	505NW505	possibly Unit 6	R	max.	edent.
148413	*Neotoma* sp.	520NW490	Unit 2 (12–14 ka)	R	dent.	i1
148414	*Neotoma* sp.	520NW490	Unit 2 (12–14 ka)	L	max.	edent.
148415	*Neotoma* sp.	580NW465	possibly Unit 3	R	dent.	edent.
148416	*Neotoma* sp.	580NW465	possibly Unit 3	L	max.	edent.
148417	*Neotoma* sp.	500NW450	Unit 1 (10–0 ka)	R	dent.	edent.
148418	*Neotoma* sp.	520NW495	Unit 1 (10–0 ka)	R	dent.	edent.
148419	*Neotoma* sp.	520NW505	Unit 2 (12–14 ka)	L	dent.	i1
148420	*Neotoma* sp.	520NW505	Unit 2 (12–14 ka)	L	dent.	i1
148421	*Neotoma* sp.	520NW505	Unit 2 (12–14 ka)	R	max.	edent.
148422	*Neotoma* sp.	525NW485	Unit 1 (10–0 ka)	R	dent.	edent.
148423	*Neotoma* sp.	525NW485	Unit 1 (10–0 ka)	L	max.	edent.
148432	*Neotoma* sp.	520NW505	Unit 2 (12–14 ka)	R	dent.	i1
148433	*Neotoma* sp.	525NW485	Unit 2 (12–14 ka)	L	dent.	edent.
148468	*Neotoma* sp.	505NW485	Unit 2 (12–14 ka)	R	max.	M2
148572	*Neotoma* sp.	505NW515	Unit 3 (17–20 ka)	R	m2	
148573	*Neotoma* sp.	495NW515	Unit 3 (17–20 ka)	L	m2	
148574	*Neotoma* sp.	495NW515	Unit 3 (17–20 ka)	?	m3	
148575	*Neotoma* sp.	510NW515	Unit 4 (20–24 ka)	L	M3	
148576	*Neotoma* sp.	510NW515B	Unit 5 (24–100 ka)	R	M2	
148580	*Neotoma* sp.	495NW515	Unit 4 (20–24 ka)	L	M2	
148581	*Neotoma* sp.	510NW515	Unit 5 (24–100 ka)	L	M2	
148582	*Neotoma* sp.	495NW515	Unit 4 (20–24 ka)	L	M3	
148583	*Neotoma* sp.	495NW515	Unit 4 (20–24 ka)	R	M3	
148584	*Neotoma* sp.	510NW515B	Unit 5 (24–100 ka)	L	M3	

148587	*Neotoma* sp.	510NW515A	Unit 5 (24–100 ka)	?	m3
148588	*Neotoma* sp.	495NW515	Unit 4 (20–24 ka)	?	m3
148590	*Neotoma* sp.	510NW515B	Unit 5 (24–100 ka)	L	M3
148591	*Neotoma* sp.	510NW515B	Unit 5 (24–100 ka)	L	M3
148595	*Neotoma* sp.	505NW520	Unit 3 (17–20 ka)	?	m3
148598	*Neotoma* sp.	495NW515	Unit 1 or 2	R	M2
148599	*Neotoma* sp.	495NW515	Unit 3 (17–20 ka)	?	molar
148600	*Neotoma* sp.	495NW515	Unit 1 or 2	?	m3
148601	*Neotoma* sp.	495NW515	Unit 3 (17–20 ka)	L	M2
148602	*Neotoma* sp.	495NW515	Unit 3 (17–20 ka)	R	M3
148603	*Neotoma* sp.	520NW490	Unit 4 (20–24 ka)	L	M1
148605	*Neotoma* sp.	495NW515	Unit 1 or 2	R	M3
148607	*Neotoma* sp.	495NW515	Unit 1 or 2	R	M3
148608	*Neotoma* sp.	495NW515	Unit 1 or 2	R	M3
148609	*Neotoma* sp.	520NW510	Unit 2 (12–14 ka)	L	M2
148610	*Neotoma* sp.	495NW515	Unit 1 or 2	?	m3
148613	*Neotoma* sp.	495NW515	Unit 3 (17–20 ka)	?	m3
148615	*Neotoma* sp.	495NW515	Unit 1 or 2	?	m3
148616	*Neotoma* sp.	495NW515	Unit 1 or 2	R	M3
148617	*Neotoma* sp.	495NW515	Unit 1 or 2	R	m1
148623	*Neotoma* sp.	495NW515	Unit 1 or 2	R	m2
148628	*Neotoma* sp.	520NW510	Unit 2 (12–14 ka)	R	M3
148629	*Neotoma* sp.	520NW510	Unit 2 (12–14 ka)	R	m1
148630	*Neotoma* sp.	520NW510	Unit 2 (12–14 ka)	L	M2
148631	*Neotoma* sp.	520NW510	Unit 2 (12–14 ka)	R	m2
148632	*Neotoma* sp.	520NW510	Unit 2 (12–14 ka)	R	m2
148643	*Neotoma* sp.	505NW530	possibly Unit 3	R	M2
148644	*Neotoma* sp.	495NW520	Unit 3 (17–20 ka)	R	m1
148645	*Neotoma* sp.	495NW520	Unit 1 (10–0 ka)	L	M2
148646	*Neotoma* sp.	495NW520	Unit 1 (10–0 ka)	R	M2
148647	*Neotoma* sp.	515NW520	Unit 3 (17–20 ka)	L	m1
148648	*Neotoma* sp.	515NW520	Unit 3 (17–20 ka)	R	M2
148650	*Neotoma* sp.	500NW520	Unit 3 (17–20 ka)	R	M3
148651	*Neotoma* sp.	500NW520	Unit 3 (17–20 ka)	L	M3
148652	*Neotoma* sp.	500NW520	Unit 3 (17–20 ka)	?	m3
148655	*Neotoma* sp.	500NW520	Unit 3 (17–20 ka)	?	m3
148656	*Neotoma* sp.	505NW515	Unit 1 or 2	L	m1
148657	*Neotoma* sp.	505NW515	Unit 1 or 2	?	m3
148658	*Neotoma* sp.	505NW515	Unit 1 or 2	R	m2
148659	*Neotoma* sp.	505NW515	Unit 1 or 2	R	m2
148660	*Neotoma* sp.	505NW515	Unit 1 or 2	R	M2
148661	*Neotoma* sp.	505NW515	Unit 1 or 2	R	M2
148662	*Neotoma* sp.	505NW515	Unit 1 or 2	R	M2
148663	*Neotoma* sp.	505NW515	Unit 1 or 2	L	m2
148664	*Neotoma* sp.	505NW515	Unit 1 or 2	?	m3
148665	*Neotoma* sp.	505NW515	Unit 1 or 2	R	M3
148666	*Neotoma* sp.	505NW515	Unit 1 or 2	?	m3
148667	*Neotoma* sp.	505NW515	Unit 1 or 2	L	M2
148670	*Neotoma* sp.	505NW515	Unit 1 or 2	L	M3
148671	*Neotoma* sp.	505NW515	Unit 1 or 2	R	M3

148672	*Neotoma* sp.	520NW490	Unit 2 (12–14 ka)	?	m3
148673	*Neotoma* sp.	520NW490	Unit 2 (12–14 ka)	R	M2
148674	*Neotoma* sp.	520NW490	Unit 2 (12–14 ka)	L	M2
148675	*Neotoma* sp.	520NW490	Unit 2 (12–14 ka)	R	m2
148676	*Neotoma* sp.	520NW490	Unit 2 (12–14 ka)	L	m1
148677	*Neotoma* sp.	505NW515	Unit 1 or 2	L	M2
148678	*Neotoma* sp.	505NW515	Unit 1 or 2	R	M2
148681	*Neotoma* sp.	520NW490	Unit 2 (12–14 ka)	L	M2
148682	*Neotoma* sp.	520NW490	Unit 2 (12–14 ka)	?	m3
148683	*Neotoma* sp.	520NW490	Unit 2 (12–14 ka)	R	M2
148684	*Neotoma* sp.	520NW490	Unit 2 (12–14 ka)	R	m1
148686	*Neotoma* sp.	520NW490	Unit 2 (12–14 ka)	?	m3
148687	*Neotoma* sp.	520NW490	Unit 2 (12–14 ka)	L	M2
148688	*Neotoma* sp.	520NW490	Unit 2 (12–14 ka)	L	M2
148689	*Neotoma* sp.	520NW490	Unit 2 (12–14 ka)	?	m3
148690	*Neotoma* sp.	520NW490	Unit 2 (12–14 ka)	?	m3
148692	*Neotoma* sp.	520NW490	Unit 2 (12–14 ka)	R	m2
148694	*Neotoma* sp.	520NW490	Unit 2 (12–14 ka)	R	M1
148695	*Neotoma* sp.	520NW490	Unit 2 (12–14 ka)	R	M2
148700	*Neotoma* sp.	520NW490	Unit 2 (12–14 ka)	R	M2
148701	*Neotoma* sp.	520NW490	Unit 2 (12–14 ka)	L	M2
148702	*Neotoma* sp.	520NW490	Unit 2 (12–14 ka)	R	M2
148703	*Neotoma* sp.	520NW490	Unit 2 (12–14 ka)	L	M3
148704	*Neotoma* sp.	520NW490	Unit 2 (12–14 ka)	L	M3
148705	*Neotoma* sp.	520NW490	Unit 2 (12–14 ka)	R	M3
148706	*Neotoma* sp.	520NW490	Unit 2 (12–14 ka)		m3
148708	*Neotoma* sp.	520NW490	Unit 2 (12–14 ka)	R	M2
148709	*Neotoma* sp.	520NW490	Unit 2 (12–14 ka)	L	M3
148712	*Neotoma* sp.	500NW520	Unit 2 (12–14 ka)	L	M2
148713	*Neotoma* sp.	500NW520	Unit 3 (17–20 ka)	R	M2
148714	*Neotoma* sp.	505NW520	Unit 1 (10–0 ka)	R	M2
148715	*Neotoma* sp.	505NW520	Unit 1 (10–0 ka)	L	m1
148719	*Neotoma* sp.	500NW520	Unit 1 or 2	L	m2
148722	*Neotoma* sp.	520NW490	Unit 1 (10–0 ka)	R	M3
148723	*Neotoma* sp.	520NW490	Unit 1 (10–0 ka)	L	m2
148724	*Neotoma* sp.	505NW520	Unit 3 (17–20 ka)	L	M2
148725	*Neotoma* sp.	505NW515	Unit 1 or 2	L	m1
148726	*Neotoma* sp.	500NW515	Unit 1 or 2	R	m1
148728	*Neotoma* sp.	500NW515	Unit 1 or 2	L	M2
148731	*Neotoma* sp.	520NW490	Unit 1 (10–0 ka)	R	m2
148732	*Neotoma* sp.	500NW515	Unit 1 or 2	R	M2
148737	*Neotoma* sp.	580NW465	possibly Unit 3		m3
148738	*Neotoma* sp.	505NW515	Unit 1 or 2	L	m2
148740	*Neotoma* sp.	520NW510	Unit 1 (10–0 ka)	R	M3
148741	*Neotoma* sp.	500NW515	Unit 3 (17–20 ka)	L	M3
148743	*Neotoma* sp.	580NW465	possibly Unit 3	L	M2
148744	*Neotoma* sp.	510NW515 B	Unit 4 (20–24 ka)		m3
148748	*Neotoma* sp.	500NW515	Unit 6 (>100 ka)	R	M2
148749	*Neotoma* sp.	500NW515	Unit 6 (>100 ka)	L	M2
148750	*Neotoma* sp.	500NW515	Unit 6 (>100 ka)		m3

148751	*Neotoma* sp.	500NW515	Unit 6 (>100 ka)		m3	
148752	*Neotoma* sp.	580NW465	possibly Unit 2	R	max.	edent.
148753	*Neotoma* sp.	500NW515	Unit 6 (>100 ka)	R	max.	edent.
148755	*Neotoma* sp.	500NW515	Unit 6 (>100 ka)	R	max.	edent.
148756	*Neotoma* sp.	580NW465	possibly Unit 3	R	dent.	edent.
148757	*Neotoma* sp.	580NW465	possibly Unit 2	L	max.	edent.
148758	*Neotoma* sp.	500NW515	Unit 6 (>100 ka)	L	dent.	edent.
148759	*Neotoma* sp.	520NW490	Unit 3 (17–20 ka)	L & R	max.	edent.
148760	*Neotoma* sp.	580NW465	possibly Unit 1	R	dent.	edent.
148901	*Neotoma* sp.	500NW515	possibly Unit 4	L	m2	
148902	*Neotoma* sp.	500NW515	possibly Unit 4	L	m2	
148903	*Neotoma* sp.	500NW515	possibly Unit 4	L	m1	
148905	*Neotoma* sp.	500NW515	possibly Unit 4	R	M3	
148907	*Neotoma* sp.	500NW515	possibly Unit 4	R	m2	
148909	*Neotoma* sp.	500NW515	possibly Unit 4	L	M2	
149047	*Neotoma* sp.	505NW515	Unit 1 or 2	R	M3	
149090	*Neotoma* sp.	505NW515	Unit 3 (17–20 ka)		m3	
149204	*Neotoma* sp.	?	n/a	L	m2	
149293	*Neotoma* sp.	500NW515	Unit 6 (>100 ka)	R	max.	M3
149325	*Neotoma* sp.	505NW505	Unit 6 (>100 ka)	L	dent.	i1 m1-2
149327	*Neotoma* sp.	505NW505	Unit 6 (>100 ka)	R	M2	
149328	*Neotoma* sp.	505NW505	Unit 6 (>100 ka)		m3	
149329	*Neotoma* sp.	510NW505	Unit 6 (>100 ka)	L	M2	
149332	*Neotoma* sp.	505NW505	Unit 6 (>100 ka)	L	M2	
149341	*Neotoma* sp.	?	Unit 6 (>100 ka)	R	M3	
149350	*Neotoma* sp.	505NW505	Unit 6 (>100 ka)	R	M3	
149351	*Neotoma* sp.	505NW505	Unit 6 (>100 ka)	?	m3	
64624	*Microtus* sp.	520NW505	Unit 2 (12–14 ka)	L	dent.	i1 m2
64702	*Microtus* sp.	slump	n/a	L	dent.	i1 m2
64770	*Microtus* sp.	520NW505	Unit 2 (12–14 ka)	L	dent.	i1 m2
64782	*Microtus* sp.	520NW490	Unit 2 (12–14 ka)	R	dent.	i1 m2
64804	*Microtus* sp.	no data	n/a	R	dent.	i1 m2
68833	*Microtus* sp.	505NW525	Unit 3 (17–20 ka)	R	m1	
84990	*Microtus* sp.	wall clean up	Unit 3 (17–20 ka)	L & R	max.	all except RM3
97238	*Microtus* sp.	515NW485	possibly Unit 1	R	dent.	i1 m2
97649	*Microtus* sp.	505NW515	Unit 3 (17–20 ka)	R	m1	
97732	*Microtus* sp.	slump	n/a	R	dent.	i1
124181	*Microtus* sp.	500NW510	Unit 1 or 2	R	dent.	i1
127040	*Microtus* sp.	500NW450	n/a	R	dent.	edent.
145163	*Microtus* sp.	510NW505	Unit 6 (>100 ka)	L	m1	
146924	*Microtus* sp.	505NW505	Unit 6 (>100 ka)	?	m1	fragment
146925	*Microtus* sp.	520NW505	Unit 2 (12–14 ka)	L	m3	
146938	*Microtus* sp.	505NW505	Unit 6 (>100 ka)	R	dent.	i1 m2
146939	*Microtus* sp.	505NW505	Unit 6 (>100 ka)	R	m1	
146941	*Microtus* sp.	505NW505	Unit 6 (>100 ka)	L	dent.	i1
146966	*Microtus* sp.	505NW505	possibly Unit 6	L	m2	
147079	*Microtus* sp.	495-500NW515	Unit 6 (>100 ka)	R	dent.	m2
147080	*Microtus* sp.	520NW495	Unit 1 (10–0 ka)	R	M3	
147081	*Microtus* sp.	510N	Unit 6 (>100 ka)	R	M3	
147082	*Microtus* sp.	500NW505	possibly Unit 6	R	dent.	edent.

148245	*Microtus* sp.	505NW485	Unit 2 (12–14 ka)	L	dent.	i1
148276	*Microtus* sp.	495NW510	Unit 1 or 2	L	dent.	i1
148287	*Microtus* sp.	495NW510	Unit 1 or 2	L	dent.	i1
148292	*Microtus* sp.	510NW515	Unit 3 (17–20 ka)	L	dent.	i1
148331	*Microtus* sp.	510NW515	Unit 2 (12–14 ka)	L	dent.	i1
148349	*Microtus* sp.	510NW485	Unit 2 (12–14 ka)	R	dent.	edent.
148400	*Microtus* sp.	510NW505	Unit 6 (>100 ka)	R	dent.	edent.
148480	*Microtus* sp.	515NW520	Unit 3 (17–20 ka)	L	m1	
148482	*Microtus* sp.	505NW515	Unit 1 or 2	L	dent.	m1
148483	*Microtus* sp.	505NW515	Unit 3 (17–20 ka)	L	m1	
148484	*Microtus* sp.	505NW515	Unit 3 (17–20 ka)	R	m3	
148485	*Microtus* sp.	520NW525	Unit 2 (12–14 ka)	R	M3	
148486	*Microtus* sp.	505NW535	Unit 3 (17–20 ka)	R	m1	
148487	*Microtus* sp.	520NW510	Unit 2 (12–14 ka)	R	dent.	m1
148488	*Microtus* sp.	520NW525	Unit 3 (17–20 ka)	L	m1	
148490	*Microtus* sp.	500NW515	Unit 1 or 2	R	m1	
148491	*Microtus* sp.	505NW525	Unit 4 (20–24 ka)	R	M3	
148495	*Microtus* sp.	520NW490	Unit 2 (12–14 ka)	L	m1	
148496	*Microtus* sp.	520NW490	Unit 2 (12–14 ka)	R	M3	
148498	*Microtus* sp.	505NW520	Unit 3 (17–20 ka)	R	m1	
148499	*Microtus* sp.	520NW490	Unit 2 (12–14 ka)	R	dent.	i1 m1-2
148500	*Microtus* sp.	520NW490	Unit 1 (10–0 ka)	L	m1	
148501	*Microtus* sp.	520NW490	Unit 2 (12–14 ka)	L	m1	
148502	*Microtus* sp.	505NW515	Unit 1 or 2	R	M3	
148503	*Microtus* sp.	500NW515	Unit 1 or 2	L	M3	
148504	*Microtus* sp.	520NW490	Unit 2 (12–14 ka)	L	m3	
148505	*Microtus* sp.	520NW490	Unit 2 (12–14 ka)	R	M3	
148506	*Microtus* sp.	520NW490	Unit 2 (12–14 ka)	R	M3	
148507	*Microtus* sp.	520NW490	Unit 2 (12–14 ka)	L	dent.	i1
148508	*Microtus* sp.	500NW520	Unit 3 (17–20 ka)	R	m1	
148509	*Microtus* sp.	520NW490	Unit 2 (12–14 ka)	R	dent.	i1
148510	*Microtus* sp.	520NW490	Unit 2 (12–14 ka)	L	M3	
148511	*Microtus* sp.	520NW490	Unit 2 (12–14 ka)	L	M3	
148512	*Microtus* sp.	580NW465	possibly Unit 3	R	m3	
148515	*Microtus* sp.	500NW515	Unit 1 or 2	R	m3	
148517	*Microtus* sp.	505NW515	Unit 1 or 2	L	dent.	edent.
148518	*Microtus* sp.	580NW465	possibly Unit 3	R	m1	
148519	*Microtus* sp.	520NW525	Unit 2 (12–14 ka)	R	m1	
148638	*Microtus* sp.	505NW535	Unit 3 (17–20 ka)	L	m1	
148640	*Microtus* sp.	505NW525	Unit 4 (20–24 ka)	R	M3	
148762	*Microtus* sp.	510NW515B	Unit 5 (24–100 ka)	L	m1	
148763	*Microtus* sp.	495NW515	Unit 1 or 2	R	m3	
148764	*Microtus* sp.	495NW515	Unit 1 or 2	R	M3	
148765	*Microtus* sp.	495NW515	Unit 4 (20–24 ka)	L	M3	
148766	*Microtus* sp.	500NW515	Unit 3 (17–20 ka)	R	dent.	m2, m3
148767	*Microtus* sp.	495NW515	Unit 3 (17–20 ka)	L	M3	
148768	*Microtus* sp.	505NW520	Unit 3 (17–20 ka)	R	m1	
148769	*Microtus* sp.	495NW515	Unit 1 or 2	L	m1	
148770	*Microtus* sp.	495NW515	Unit 4 (20–24 ka)	R	m1	
148772	*Microtus* sp.	505NW520	Unit 3 (17–20 ka)	L	m1	

148773	*Microtus* sp.	510NW515A	Unit 5 (24–100 ka)	L	m1	
148774	*Microtus* sp.	510NW515A	Unit 5 (24–100 ka)	R	m1	
148775	*Microtus* sp.	495NW515	Unit 4 (20–24 ka)	R	M3	
148776	*Microtus* sp.	510NW515B	Unit 5 (24–100 ka)	R	m1	
148777	*Microtus* sp.	495NW515	Unit 3 (17–20 ka)	L	dent.	edent.
148778	*Microtus* sp.	495NW515	Unit 1 or 2	L	m3	
148779	*Microtus* sp.	520NW495	Unit 2 (12–14 ka)	R	M3	
148781	*Microtus* sp.	520NW490	Unit 2 (12–14 ka)	L	dent.	i1 m1
148782	*Microtus* sp.	495NW515	Unit 1 or 2	L	dent.	edent.
148783	*Microtus* sp.	510NW515B	Unit 5 (24–100 ka)	L	dent.	edent.
148784	*Microtus* sp.	495NW515	Unit 3 (17–20 ka)	L	dent.	edent.
149090	*Microtus* sp.	505NW515	Unit 3 (17–20 ka)	R	m3	
149273	*Microtus* sp.	517NW515	Unit 1 (10–0 ka)	L	m1	
149296	*Microtus* sp.	517NW515	Unit 1 (10–0 ka)	L	dent.	i1
149312	*Microtus* sp.	510NW485	Unit 2 (12–14 ka)	R	m1	
148497	*Microtus montanus*	505NW515	Unit 1 or 2	L	m1	
42530	*Microtus longicaudus*	?	Unit 3 (17–20 ka)	R	m1	
64625	*Microtus longicaudus*	520NW505	Unit 2 (12–14 ka)	R	dent.	i1 m1 m2
64664	*Microtus longicaudus*	500NW450	possibly Unit 3	R	dent.	i1 m1 m2
64665	*Microtus longicaudus*	500NW450	possibly Unit 3	L	dent.	i1 m1 m2
64707	*Microtus longicaudus*	Contig. square	n/a	R	dent.	i1 m1 m2
64747	*Microtus longicaudus*	500NW450	Unit 1 (10–0 ka)	L	dent.	i1 m1 m2
64748	*Microtus longicaudus*	500NW450	Unit 1 (10–0 ka)	R	dent.	i1 m1 m2
64750	*Microtus longicaudus*	500NW450	Unit 1 (10–0 ka)	L	dent.	i1 m1 m2
64751	*Microtus longicaudus*	500NW450	Unit 1 (10–0 ka)	R	dent.	i1 m1 m2
64779	*Microtus longicaudus*	520NW505	Unit 2 (12–14 ka)	L	dent.	i1 m1 m2
64781	*Microtus longicaudus*	520NW490	Unit 2 (12–14 ka)	R	m1	
64823	*Microtus longicaudus*	515NW485	Unit 2 (12–14 ka)	R	dent.	i1 m1 m2
67192	*Microtus longicaudus*	520NW490	Unit 1 (10–0 ka)	L	dent.	i1 m1 m2
97347	*Microtus longicaudus*	517NW515	n/a	R	dent.	i1 m1
145143	*Microtus longicaudus*	500NW450	Unit 1 (10–0 ka)	R	m1	
145144	*Microtus longicaudus*	520NW495	Unit 1 (10–0 ka)	R	m1	
145145	*Microtus longicaudus*	510NW505	Unit 6 (>100 ka)	L	m1	
145146	*Microtus longicaudus*	505NW505	Unit 6 (>100 ka)	R	m1	
145147	*Microtus longicaudus*	505NW505	Unit 6 (>100 ka)	L	m1	
145148	*Microtus longicaudus*	505NW505	possibly Unit 6	L	dent.	i1 m1
145149	*Microtus longicaudus*	500NW450	Unit 1 (10–0 ka)	R	dent.	m1 m2
145150	*Microtus longicaudus*	505NW505	possibly Unit 6	L	m1	
145151	*Microtus longicaudus*	505NW505	Unit 6 (>100 ka)	R	m1	
145152	*Microtus longicaudus*	500NW450	Unit 1 (10–0 ka)	R	dent.	i1 m1 m2
145153	*Microtus longicaudus*	505NW505	Unit 6 (>100 ka)	R	m1	
145154	*Microtus longicaudus*	505NW505	Unit 6 (>100 ka)	L	m1	
145155	*Microtus longicaudus*	495-500NW515	Unit 6 (>100 ka)	L	m1	
145158	*Microtus longicaudus*	525NW485	Unit 1 (10–0 ka)	L	m1	
147845	*Microtus longicaudus*	517NW515	n/a	R	m1	
147956	*Microtus longicaudus*	520NW490	Unit 2 (12–14 ka)	R	dent.	i1, m1-2
148330	*Microtus longicaudus*	510NW515	Unit 2 (12–14 ka)	L	m1	
148481	*Microtus longicaudus*	495NW520	Unit 3 (17–20 ka)	L	m1	
148489	*Microtus longicaudus*	495NW515	Unit 3 (17–20 ka)	L	m1	
148492	*Microtus longicaudus*	495NW515	Unit 3 (17–20 ka)	R	m1	

148493	*Microtus longicaudus*	520NW495	Unit 2 (12–14 ka)	L	m1	
148494	*Microtus longicaudus*	500NW520	Unit 2 (12–14 ka)	R	m1	
148513	*Microtus longicaudus*	500NW515	Unit 3 (17–20 ka)	R	m1	
148514	*Microtus longicaudus*	505NW515	Unit 1 or 2	R	m1	
148516	*Microtus longicaudus*	520NW490	Unit 2 (12–14 ka)	R	m1	
148639	*Microtus longicaudus*	505NW525	Unit 3 (17–20 ka)	L	m1	
148761	*Microtus longicaudus*	510NW515A	Unit 5 (24–100 ka)	R	m1	
148771	*Microtus longicaudus*	510NW515B	Unit 5 (24–100 ka)	L	m1	
148780	*Microtus longicaudus*	500NW515	Unit 3 (17–20 ka)	L	m1	
64791	*Microtus ochrogaster*	517NW515	Unit 3 (17–20 ka)	R	dent.	i1 m1 m2
64622	*Microtus ochrogaster*	520NW505	Unit 2 (12–14 ka)	L	dent.	i1 m1 m2
67890	*Microtus ochrogaster*	505NW485	Unit 2 (12–14 ka)	R	dent.	i1 m1
148785	*Microtus ochrogaster*	510NW515A	Unit 5 (24–100 ka)	L	m1	
148786	*Microtus ochrogaster*	520NW490	Unit 2 (12–14 ka)	L	dent.	i1 m1
64826	*Microtus* cf. *miurus*	515NW485	Unit 2 (12–14 ka)	L	dent.	i1 m1 m2
64623	*Lemmiscus curtatus*	520NW505	Unit 2 (12–14 ka)	R	dent.	
64657	*Lemmiscus curtatus*	500NW450	Unit 1 (10–0 ka)	L	dent.	
64671	*Lemmiscus curtatus*	520NW505	Unit 2 (12–14 ka)	R	m1	
64709	*Lemmiscus curtatus*	Trench	n/a	R	dent.	
64744	*Lemmiscus curtatus*	500NW450	Unit 1 (10–0 ka)	L	dent.	
64746	*Lemmiscus curtatus*	500NW450	Unit 1 (10–0 ka)	R	dent.	
98103	*Lemmiscus curtatus*	520NW505	Unit 1 (10–0 ka)	L	dent.	
124180	*Lemmiscus curtatus*	500NW510	Unit 1 or 2	L	dent.	
124182	*Lemmiscus curtatus*	500NW510	Unit 1 or 2	R	dent.	
145159	*Lemmiscus curtatus*	500NW505	possibly Unit 1	R	m1	
145160	*Lemmiscus curtatus*	500NW450	Unit 1 (10–0 ka)	R	m1	
145161	*Lemmiscus curtatus*	525NW485	Unit 1 (10–0 ka)	L	dent.	
145162	*Lemmiscus curtatus*	510NW505	Unit 6 (>100 ka)	L	m1	
145164	*Lemmiscus curtatus*	520NW505	Unit 2 (12–14 ka)	R	m1	
145165	*Lemmiscus curtatus*	495-500NW515	Unit 6 (>100 ka)	L	m1	
145166	*Lemmiscus curtatus*	500NW505	possibly Unit 1	L	m1	
145167	*Lemmiscus curtatus*	510NW505	Unit 6 (>100 ka)	R	m1	
145168	*Lemmiscus curtatus*	510N	Unit 6 (>100 ka)	L	m1	
145169	*Lemmiscus curtatus*	520NW505	Unit 2 (12–14 ka)	L	m1	
145170	*Lemmiscus curtatus*	?	Unit 3 (17–20 ka)	R	m1	
145171	*Lemmiscus curtatus*	505NW505	Unit 6 (>100 ka)	R	m1	
145172	*Lemmiscus curtatus*	505NW505	Unit 6 (>100 ka)	L	m1	
145173	*Lemmiscus curtatus*	505NW505	Unit 6 (>100 ka)	L	m1	
146967	*Lemmiscus curtatus*	500NW450	Unit 1 (10–0 ka)	L	dent.	
146968	*Lemmiscus curtatus*	500NW450	Unit 1 (10–0 ka)	L	dent.	
147083	*Lemmiscus curtatus*	505NW505	possibly Unit 1	R	M3	
148152	*Lemmiscus curtatus*	?	Unit 6 (>100 ka)	R	dent.	
148252	*Lemmiscus curtatus*	505NW485	Unit 2 (12–14 ka)	R	m1	
148288	*Lemmiscus curtatus*	495NW510	Unit 1 or 2	L	dent.	
148316	*Lemmiscus curtatus*	480NW515	possibly Unit 1	L	M3	
148352	*Lemmiscus curtatus*	510NW485	Unit 2 (12–14 ka)	R	dent.	
148394	*Lemmiscus curtatus*	?	Unit 6 (>100 ka)	L	dent.	
148470	*Lemmiscus curtatus*	505NW520	Unit 3 (17–20 ka)	R	M3	
148471	*Lemmiscus curtatus*	495NW515	Unit 3 (17–20 ka)	L	m3	
148472	*Lemmiscus curtatus*	495NW515	Unit 3 (17–20 ka)	L	dent.	i1 m1-3

148473	*Lemmiscus curtatus*	495NW515	Unit 3 (17–20 ka)	L	m1	
148474	*Lemmiscus curtatus*	510NW515A	Unit 5 (24–100 ka)	L	dent.	m1-2
148475	*Lemmiscus curtatus*	495NW515	Unit 4 (20–24 ka)	R	m1	
148476	*Lemmiscus curtatus*	495NW515	Unit 3 (17–20 ka)	L	m1	
148477	*Lemmiscus curtatus*	495NW515	Unit 3 (17–20 ka)	L	dent.	m1-2
148478	*Lemmiscus curtatus*	510NW515B	Unit 5 (24–100 ka)	L	M3	
148479	*Lemmiscus curtatus*	510NW515	Unit 5 (24–100 ka)	L	m1	
148520	*Lemmiscus curtatus*	500NW520	Unit 1 (10–0 ka)	R	M3	
148521	*Lemmiscus curtatus*	500NW520	Unit 3 (17–20 ka)	L	M3	
148522	*Lemmiscus curtatus*	500NW520	Unit 3 (17–20 ka)	L	dent.	i1 m1
148523	*Lemmiscus curtatus*	505NW520	Unit 3 (17–20 ka)	R	m1	
148524	*Lemmiscus curtatus*	500NW515	Unit 1 or 2	R	m1	
148525	*Lemmiscus curtatus*	520NW490	Unit 1 (10–0 ka)	R	m1	
148526	*Lemmiscus curtatus*	500NW520	Unit 2 (12–14 ka)	R	m1	
148527	*Lemmiscus curtatus*	500NW515	Unit 3 (17–20 ka)	R	m1	
148528	*Lemmiscus curtatus*	520NW490	Unit 1 (10–0 ka)	L	M3	
148529	*Lemmiscus curtatus*	520NW490	Unit 2 (12–14 ka)	R	M3	
148530	*Lemmiscus curtatus*	505NW515	Unit 3 (17–20 ka)	R	m1	
148531	*Lemmiscus curtatus*	520NW490	Unit 2 (12–14 ka)	L	M3	
148532	*Lemmiscus curtatus*	505NW515	Unit 1 or 2	R	m3	
148533	*Lemmiscus curtatus*	520NW490	Unit 2 (12–14 ka)	R	M3	
148534	*Lemmiscus curtatus*	520NW490	Unit 2 (12–14 ka)	R	M3	
148535	*Lemmiscus curtatus*	500NW515	Unit 6 (>100 ka)	R	m1	
148536	*Lemmiscus curtatus*	520NW490	Unit 2 (12–14 ka)	R	dent.	m1
148537	*Lemmiscus curtatus*	505NW520	Unit 3 (17–20 ka)	R	dent.	i1 m1-2
148538	*Lemmiscus curtatus*	520NW490	Unit 2 (12–14 ka)	L	m1	
148539	*Lemmiscus curtatus*	520NW490	Unit 3 (17–20 ka)	R	dent.	i1
148540	*Lemmiscus curtatus*	500NW520	Unit 3 (17–20 ka)	R	m1	
148541	*Lemmiscus curtatus*	500NW515	Unit 3 (17–20 ka)	L	dent.	m1-m2
148542	*Lemmiscus curtatus*	500NW515	Unit 3 (17–20 ka)	L	m1	
148543	*Lemmiscus curtatus*	520NW490	Unit 2 (12–14 ka)	R	M3	
148544	*Lemmiscus curtatus*	495NW515	Unit 3 (17–20 ka)	L	M3	
148545	*Lemmiscus curtatus*	495NW515	Unit 3 (17–20 ka)	R	m1	
148546	*Lemmiscus curtatus*	495NW515	Unit 3 (17–20 ka)	L	m1	
148547	*Lemmiscus curtatus*	500NW515	Unit 3 (17–20 ka)	R	m1	
148548	*Lemmiscus curtatus*	505NW525	Unit 3 (17–20 ka)	L	M3	
148549	*Lemmiscus curtatus*	520NW490	Unit 1 (10–0 ka)	R	dent.	m1
148550	*Lemmiscus curtatus*	505NW515	Unit 3 (17–20 ka)	L	dent.	i1 m1
148551	*Lemmiscus curtatus*	500NW515	possibly Unit 1	L	m1	
148552	*Lemmiscus curtatus*	505NW515	Unit 1 or 2	L	m1	
148553	*Lemmiscus curtatus*	505NW515	Unit 3 (17–20 ka)	L	dent.	i1
148554	*Lemmiscus curtatus*	505NW515	Unit 1 or 2	R	m3	
148555	*Lemmiscus curtatus*	520NW490	Unit 2 (12–14 ka)	R	m1	
148556	*Lemmiscus curtatus*	520NW490	Unit 2 (12–14 ka)	L	m3	
149037	*Lemmiscus curtatus*	495NW515	Unit 4 (20–24 ka)	R	m1	
149038	*Lemmiscus curtatus*	495NW515	Unit 4 (20–24 ka)	L	M3	
43738	*Dicrostonyx* sp.	505NW525	Unit 3 (17–20 ka)	R	m1	
43740	*Dicrostonyx* sp.	505NW525	Unit 3 (17–20 ka)	R	m1	
148882	*Dicrostonyx* sp.	505NW515	Unit 3 (17–20 ka)	R	M1	
148883	*Dicrostonyx* sp.	505NW515	Unit 3 (17–20 ka)	L	M1	

148884	*Dicrostonyx* sp.	505NW515	Unit 3 (17–20 ka)	R	M1
148888	*Dicrostonyx* sp.	520NW525	Unit 2 (12–14 ka)	L	M2
148881	*Dicrostonyx groenlandicus*	505NW515	Unit 3 (17–20 ka)	R	m3
148885	*Dicrostonyx groenlandicus*	505NW520	Unit 3 (17–20 ka)	L	m3
148886	*Dicrostonyx groenlandicus*	505NW535	Unit 2 (12–14 ka)	R	m3
148887	*Dicrostonyx groenlandicus*	505NW525	possibly Unit 2	R	m3

Appendix 1.2. Geomyidae

Cat. #	ID	Square	Unit	Side	Element	Dentition
64645	*Thomomys* sp.	520NW505	Unit 2 (12–14 ka)	R	dent.	i1, m1-2
64673	*Thomomys* sp.	520NW505	Unit 2 (12–14 ka)	R	dent.	i1, m1-2
67936	*Thomomys* sp.	525NW485	Unit 1 (10–0 ka)	L	dent.	i1, m1-2
97320	*Thomomys* sp.	slump	n/a	L	dent.	i1, m1-2
124044	*Thomomys* sp.	500NW510	Unit 1 or 2	L	dent.	i1, m1-2
124739	*Thomomys* sp.	505NW510	Unit 1 or 2	R	dent.	i1, m1
127096	*Thomomys* sp.	505NW485	Unit 2 (12–14 ka)	R	dent.	i1, m1-2
147637	*Thomomys* sp.	n/a	n/a	R	dent.	i1, m1-2
147638	*Thomomys* sp.	500NW515	Unit 1 (10–0 ka)	R	dent.	i1, m1-2
147641	*Thomomys* sp.	contiguous square	n/a	L	dent.	i1, m1-2
147647	*Thomomys* sp.	500NW515	n/a	L	dent.	i1, m1
147663	*Thomomys* sp.	520NW505	Unit 2 (12–14 ka)	R	dent.	i1, m1
147664	*Thomomys* sp.	520NW505	Unit 2 (12–14 ka)	L	dent.	i1, m1-2
147665	*Thomomys* sp.	520NW505	Unit 2 (12–14 ka)	R	dent.	i1, m1
147667	*Thomomys* sp.	520NW505	Unit 2 (12–14 ka)	R	dent.	i1, m1-2
147668	*Thomomys* sp.	520NW505	Unit 2 (12–14 ka)	L	dent.	i1, m1-2
147669	*Thomomys* sp.	520NW505	Unit 2 (12–14 ka)	L	dent.	i1, m1-2
147681	*Thomomys* sp.	520NW505	Unit 1 (10–0 ka)	L	dent.	i1, m2
147686	*Thomomys* sp.	500NW450	Unit 1 (10–0 ka)	L	dent.	i1, m1-2
147688	*Thomomys* sp.	500NW450	Unit 1 (10–0 ka)	R	dent.	i1, m1-2
147706	*Thomomys* sp.	515NW485	Unit 2 (12–14 ka)	R	dent.	i1, m1-2
147707	*Thomomys* sp.	520NW500	Unit 2 (12–14 ka)	R	dent.	i1, m1
147708	*Thomomys* sp.	E Wall A Leo Squ.	n/a	L	dent.	i1, m1
148435	*Thomomys* sp.	n/a	n/a	L & R	premax.	L I1
26262	*Thomomys talpoides*	510NW500	possibly Unit 2	R	jaw	i1, p4, m1-2
64635	*Thomomys talpoides*	520NW505	Unit 2 (12–14 ka)	R	jaw	i1, p4, m1-2
64637	*Thomomys talpoides*	520NW505	Unit 2 (12–14 ka)	L	jaw	i1, p4, m1-2
64638	*Thomomys talpoides*	520NW505	Unit 2 (12–14 ka)	R	jaw	i1, p4, m2
64639	*Thomomys talpoides*	520NW505	Unit 2 (12–14 ka)	L	jaw	i1, p4, m1-2
64640	*Thomomys talpoides*	520NW505	Unit 2 (12–14 ka)	n/a	skull	LR I1, LR M1
64641	*Thomomys talpoides*	520NW505	Unit 2 (12–14 ka)	n/a	skull	edent
64643	*Thomomys talpoides*	520NW505	Unit 2 (12–14 ka)	L	jaw	i1, p4, m1-2
64644	*Thomomys talpoides*	520NW505	Unit 2 (12–14 ka)	L	jaw	i1, p4, m1-2
64646	*Thomomys talpoides*	520NW505	Unit 2 (12–14 ka)	R	jaw	i1, p4, m1
64647	*Thomomys talpoides*	520NW505	Unit 2 (12–14 ka)	n/a	skull	edent
64648	*Thomomys talpoides*	520NW505	Unit 2 (12–14 ka)	L	jaw	i1, p4, m1-2
64653	*Thomomys talpoides*	500NW450	Unit 1 (10–0 ka)	R	jaw	i1, p4, m1-2
64654	*Thomomys talpoides*	500NW450	Unit 1 (10–0 ka)	L	jaw	i1, p4, m1-2
64655	*Thomomys talpoides*	500NW450	Unit 1 (10–0 ka)	L	jaw	i1, p4, m1-2
64681	*Thomomys talpoides*	525NW485	Unit 1 (10–0 ka)	R	jaw	p4, m1-2
64682	*Thomomys talpoides*	525NW485	Unit 1 (10–0 ka)	L	jaw	i1, p4, m1-2
64687	*Thomomys talpoides*	530NW510	Unit 2 (12–14 ka)	R	jaw	i1, p4, m1
64715	*Thomomys talpoides*	slump	?	L	jaw	i1, p4, m1-2
64732	*Thomomys talpoides*	Slump from E Wall A Lion's squ.	?	R	jaw	i1, p4, m1
64743	*Thomomys talpoides*	500NW450	Unit 1 (10–0 ka)	L	jaw	i1, p4
64745	*Thomomys talpoides*	500NW450	Unit 1 (10–0 ka)	R	jaw	i1, p4, m1-2

64793	*Thomomys talpoides*	520NW500	Unit 2 (12–14 ka)	n/a	skull	LR I1/RP4,M1-2/LM1-2
64797	*Thomomys talpoides*	525NW485	Unit 2 (12–14 ka)	L	jaw	i1, p4, m1-2
64810	*Thomomys talpoides*	520NW505	Unit 2 (12–14 ka)	R	jaw	complete
64824	*Thomomys talpoides*	515NW485	Unit 2 (12–14 ka)	R	jaw	p4, m1-2
67133	*Thomomys talpoides*	505NW485	Unit 2 (12–14 ka)	n/a	skull	L I1
68561	*Thomomys talpoides*	510NW485	Unit 2 (12–14 ka)	n/a	skull	L m2-3
68562	*Thomomys talpoides*	510NW485	Unit 2 (12–14 ka)	n/a	skull	edent
68567	*Thomomys talpoides*	510NW485	Unit 2 (12–14 ka)	n/a	skull	LM3
98107	*Thomomys talpoides*	520NW505	Unit 1 (10–0 ka)	R	p4	
98112	*Thomomys talpoides*	520NW505	Unit 1 (10–0 ka)	L	p4	
98114	*Thomomys talpoides*	520NW505	Unit 1 (10–0 ka)	L	p4	
124043	*Thomomys talpoides*	500NW510	Unit 1 or 2	R	jaw	i1, p4
124045	*Thomomys talpoides*	500NW510	Unit 1 or 2	R	jaw	i1, p4, m1
124733	*Thomomys talpoides*	505NW510	Unit 1 or 2	n/a	skull	LR I1
124741	*Thomomys talpoides*	505NW510	Unit 1 or 2	R	p4	
141893	*Thomomys talpoides*	500NW450	Unit 1 (10–0 ka)	L	jaw	i1, p4, m1-2
141894	*Thomomys talpoides*	500NW450	Unit 1 (10–0 ka)	R	jaw	i1, p4, m1-2
141895	*Thomomys talpoides*	500NW450	Unit 1 (10–0 ka)	L	jaw	i1, p4, m1-2
141896	*Thomomys talpoides*	500NW450	Unit 1 (10–0 ka)	R	jaw	p4
141897	*Thomomys talpoides*	500NW450	Unit 1 (10–0 ka)	L	jaw	i1, p4
141898	*Thomomys talpoides*	500NW450	Unit 1 (10–0 ka)	L	p4	
147639	*Thomomys talpoides*	520NW505	Unit 2 (12–14 ka)	L	p4	
147640	*Thomomys talpoides*	no data	?	L and R	max.	edent
147643	*Thomomys talpoides*	no data	?	R	p4	
147644	*Thomomys talpoides*	no data	?	L	p4	
147645	*Thomomys talpoides*	525NW485	Unit 1 (10–0 ka)	L	p4	
147646	*Thomomys talpoides*	525NW485	Unit 1 (10–0 ka)	L	p4	
147649	*Thomomys talpoides*	500NW515	Unit 1 (10–0 ka)	R	p4	
147650	*Thomomys talpoides*	485-490NW515	Unit 5 (24–100 ka)	R	p4	
147652	*Thomomys talpoides*	517NW515	Unit 3 (17–20 ka)	L	p4	
147653	*Thomomys talpoides*	520NW490	Unit 2 (12–14 ka)	n/a	skull	LR I1, L M1, LR M2
147656	*Thomomys talpoides*	510NW500	possibly Unit 2	R	p4	
147657	*Thomomys talpoides*	510NW500	possibly Unit 2	R	p4	
147658	*Thomomys talpoides*	510NW500	possibly Unit 2	R	p4	
147659	*Thomomys talpoides*	510NW500	possibly Unit 2	R	p4	
147660	*Thomomys talpoides*	510NW500	possibly Unit 2	R	p4	
147661	*Thomomys talpoides*	520NW505	Unit 2 (12–14 ka)	R	jaw	i1, p4, m1
147662	*Thomomys talpoides*	520NW505	Unit 2 (12–14 ka)	R	jaw	i1, p4, m1-2
147670	*Thomomys talpoides*	520NW505	Unit 2 (12–14 ka)	L	p4	
147671	*Thomomys talpoides*	520NW505	Unit 2 (12–14 ka)	R	p4	
147673	*Thomomys talpoides*	520NW505	Unit 2 (12–14 ka)	L	p4	
147674	*Thomomys talpoides*	520NW505	Unit 2 (12–14 ka)	R	p4	
147675	*Thomomys talpoides*	520NW505	Unit 2 (12–14 ka)	L	p4	
147676	*Thomomys talpoides*	520NW505	Unit 2 (12–14 ka)	L	p4	
147677	*Thomomys talpoides*	520NW505	Unit 2 (12–14 ka)	R	p4	
147678	*Thomomys talpoides*	520NW505	Unit 2 (12–14 ka)	R	p4	
147679	*Thomomys talpoides*	520NW505	Unit 2 (12–14 ka)	L	p4	
147680	*Thomomys talpoides*	525NW485	Unit 1 (10–0 ka)	L	p4	

147682	*Thomomys talpoides*	500NW510	Unit 3 (17–20 ka)	L	jaw	i1, p4, m1-2
147683	*Thomomys talpoides*	520NW510	Unit 2 (12–14 ka)	L	p4	
147684	*Thomomys talpoides*	slump	?	R	p4	
147685	*Thomomys talpoides*	520NW510	Unit 2 (12–14 ka)	L	jaw	i1, p4, m1-2
147687	*Thomomys talpoides*	screening cleanup	?	L	p4	
147689	*Thomomys talpoides*	500NW450	Unit 1 (10–0 ka)	L	jaw	i1, p4, m1-2
147690	*Thomomys talpoides*	520NW505	Unit 2 (12–14 ka)	L	jaw	i1, p4, m1-2
147691	*Thomomys talpoides*	515NW485	Unit 1 (10–0 ka)	R	p4	
147692	*Thomomys talpoides*	Slump E Wall Leo squ.	?	L	p4	
147693	*Thomomys talpoides*	520NW505	Unit 2 (12–14 ka)	L	jaw	i1, p4, m1-2
147694	*Thomomys talpoides*	520NW505	Unit 2 (12–14 ka)	R	jaw	i1, p4
147695	*Thomomys talpoides*	520NW505	Unit 2 (12–14 ka)	R	jaw	i1, p4, m1-2
147696	*Thomomys talpoides*	520NW505	Unit 2 (12–14 ka)	L	jaw	i1, p4, m1-2
147697	*Thomomys talpoides*	wall cleanup	Unit 3 (17–20 ka)	R	jaw	i1, p4, m1-2
147698	*Thomomys talpoides*	slump	?	L	jaw	p4
147699	*Thomomys talpoides*	520NW495	Unit 1 (10–0 ka)	L	p4	
147700	*Thomomys talpoides*	520NW505	Unit 2 (12–14 ka)	R	jaw	i1, p4, m1-2
147701	*Thomomys talpoides*	slump	?	R	jaw	p4
147702	*Thomomys talpoides*	520NW505	Unit 2 (12–14 ka)	L	jaw	i1, p4, m1-2
147703	*Thomomys talpoides*	580NW465	possibly Unit 3	n/a	skull	LR I1, LR M1
147704	*Thomomys talpoides*	580NW465	possibly Unit 3	n/a	skull	LR I1, LR P4
147705	*Thomomys talpoides*	580NW465	possibly Unit 3	n/a	skull	R M1, L M1-3
147709	*Thomomys talpoides*	525NW485	Unit 2 (12–14 ka)	R	jaw	i1, p4
147710	*Thomomys talpoides*	525NW485	Unit 2 (12–14 ka)	L	p4	
147819	*Thomomys talpoides*	520NW505	Unit 1 (10–0 ka)	R	p4	
147843	*Thomomys talpoides*	520NW490	Unit 1 (10–0 ka)	L	p4	
147938	*Thomomys talpoides*	520NW490	Unit 2 (12–14 ka)	L	jaw	i1, p4, m2
147939	*Thomomys talpoides*	500NW450	Unit 1 (10–0 ka)	R	jaw	p4
147957	*Thomomys talpoides*	500NW450	Unit 1 (10–0 ka)	L & R	max.	R P4
147963	*Thomomys talpoides*	505NW505	Unit 6 (>100 ka)	L	p4	
147970	*Thomomys talpoides*	510NW505	possibly Unit 6	L	jaw	i1 p4
148198	*Thomomys talpoides*	505NW485	Unit 2 (12–14 ka)	L	p4	
148199	*Thomomys talpoides*	505NW485	Unit 2 (12–14 ka)	R	p4	
148200	*Thomomys talpoides*	520NW505	Unit 2 (12–14 ka)	R	p4	
148201	*Thomomys talpoides*	520NW505	Unit 2 (12–14 ka)	L	p4	
148246	*Thomomys talpoides*	505NW485	Unit 2 (12–14 ka)	L	jaw	i1, p4-m2
148247	*Thomomys talpoides*	505NW485	Unit 2 (12–14 ka)	R	p4	
148248	*Thomomys talpoides*	505NW485	Unit 1 (10–0 ka)	L	p4	
148248	*Thomomys talpoides*	500NW450	Unit 2 (12–14 ka)	n/a	palate	edent
148249	*Thomomys talpoides*	505NW485	Unit 1 (10–0 ka)	R	p4	
148249	*Thomomys talpoides*	500NW450	Unit 2 (12–14 ka)	n/a	palate	edent
148268	*Thomomys talpoides*	505NW485	Unit 2 (12–14 ka)	L	p4	
148269	*Thomomys talpoides*	505NW485	Unit 2 (12–14 ka)	R	p4	
148325	*Thomomys talpoides*	510NW485	Unit 2 (12–14 ka)	n/a	skull	L M2
148326	*Thomomys talpoides*	510NW485	Unit 2 (12–14 ka)	R	p4	
148327	*Thomomys talpoides*	510NW485	Unit 2 (12–14 ka)	L	p4	
148328	*Thomomys talpoides*	510NW485	Unit 2 (12–14 ka)	L	p4	
148329	*Thomomys talpoides*	510NW485	Unit 2 (12–14 ka)	L	p4	
148332	*Thomomys talpoides*	510NW485	Unit 2 (12–14 ka)	L	p4	
148353	*Thomomys talpoides*	510NW485	Unit 2 (12–14 ka)	L	p4	

148366	*Thomomys talpoides*	510NW485	Unit 2 (12–14 ka)	L	p4	
148367	*Thomomys talpoides*	510NW485	Unit 2 (12–14 ka)	R	p4	
148370	*Thomomys talpoides*	495NW515	Unit 1 or 2	L	jaw	i1, p4-m2
148374	*Thomomys talpoides*	485NW505	Unit 1 (10–0 ka)	L	p4	
148408	*Thomomys talpoides*	510NW505	Unit 6 (>100 ka)	n/a	palate	edent
148426	*Thomomys talpoides*	525NW485	Unit 1 (10–0 ka)	R	p4	
148427	*Thomomys talpoides*	500NW450	Unit 1 (10–0 ka)	n/a	palate	edent
148428	*Thomomys talpoides*	500NW450	Unit 1 (10–0 ka)	n/a	palate	edent
148430	*Thomomys talpoides*	520NW490	Unit 3 (17–20 ka)	n/a	skull	edent
148431	*Thomomys talpoides*	500NW450	possibly Unit 3	n/a	skull	edent
148557	*Thomomys talpoides*	510NW515B	Unit 5 (24–100 ka)	L	p4	
148558	*Thomomys talpoides*	510NW515A	Unit 4 (20–24 ka)	R	p4	
148559	*Thomomys talpoides*	495NW515	Unit 4 (20–24 ka)	R	p4	
148560	*Thomomys talpoides*	510NW515B	Unit 5 (24–100 ka)	R	p4	
148561	*Thomomys talpoides*	510NW515	Unit 5 (24–100 ka)	R	p4	
148562	*Thomomys talpoides*	495NW515	Unit 3 (17–20 ka)	L	p4	
148563	*Thomomys talpoides*	505NW515	Unit 3 (17–20 ka)	L	p4	
148564	*Thomomys talpoides*	495NW515	Unit 3 (17–20 ka)	R	p4	
148565	*Thomomys talpoides*	520NW490	Unit 2 (12–14 ka)	R	p4	
148566	*Thomomys talpoides*	505NW530	Unit 2 (12–14 ka)	L	p4	
148567	*Thomomys talpoides*	520NW490	Unit 2 (12–14 ka)	L	p4	
148568	*Thomomys talpoides*	500NW515	possibly Unit 1	L	p4	
148569	*Thomomys talpoides*	500NW515	possibly Unit 1	R	p4	
148570	*Thomomys talpoides*	500NW515	Unit 3 (17–20 ka)	R	p4	
149275	*Thomomys talpoides*	495NW510	Unit 1 or 2	L	jaw	i1, p4, m1-2

Appendix 1.3. Leporidae

Cat. #	ID	Square	Unit	Side	Element
27408	*Sylvilagus* sp.	510NW500	n/a	L	dent.
27541	*Sylvilagus* sp.	580NW465	n/a	L	dent.
26205	*Sylvilagus* sp.	535NW490	Unit 3 (17–20 ka)	R	dent.
26212	*Sylvilagus* sp.	535NW490	Unit 3 (17–20 ka)	L	dent.
26213	*Sylvilagus* sp.	535NW490	Unit 3 (17–20 ka)	L	dent.
26214	*Sylvilagus* sp.	535NW490	Unit 3 (17–20 ka)	L	dent.
26217	*Sylvilagus* sp.	535NW490	Unit 3 (17–20 ka)	L	p3
26219	*Sylvilagus* sp.	535NW490	Unit 3 (17–20 ka)	L	p3
47414	*Sylvilagus* sp.	510NW485	Unit 4 (20–24 ka)	L	dent.
52369	*Sylvilagus* sp.	500NW515	Unit 3 (17–20 ka)	R	dent.
61766	*Sylvilagus* sp.	slump	n/a	L	dent.
61776	*Sylvilagus* sp.	slump	n/a	L	dent.
61867	*Sylvilagus* sp.	slump	n/a	R	dent.
62132	*Sylvilagus* sp.	slump	n/a	R	dent.
62296	*Sylvilagus* sp.	slump	n/a	R	dent.
62511	*Sylvilagus* sp.	485-490NW515	Unit 5 (24–100 ka)	L	dent.
62550	*Sylvilagus* sp.	slump	n/a	R	dent.
64611	*Sylvilagus* sp.	520NW505	Unit 2 (12–14 ka)	L	dent.
64627	*Sylvilagus* sp.	520NW505	Unit 2 (12–14 ka)	L	mailla
64628	*Sylvilagus* sp.	520NW505	Unit 2 (12–14 ka)	L	dent.
64629	*Sylvilagus* sp.	520NW505	Unit 2 (12–14 ka)	L	dent.
64631	*Sylvilagus* sp.	520NW505	Unit 2 (12–14 ka)	R	dent.
64632	*Sylvilagus* sp.	520NW505	Unit 2 (12–14 ka)	R	dent.
64633	*Sylvilagus* sp.	520NW505	Unit 2 (12–14 ka)	R	dent.
64634	*Sylvilagus* sp.	520NW505	Unit 2 (12–14 ka)	R	dent.
64636	*Sylvilagus* sp.	520NW505	Unit 2 (12–14 ka)	R	max
64667	*Sylvilagus* sp.	500NW450	n/a	R	dent.
64670	*Sylvilagus* sp.	520NW505	Unit 2 (12–14 ka)	L	dent.
64683	*Sylvilagus* sp.	525NW485	Unit 1 (10–0 ka)	R	dent.
64688	*Sylvilagus* sp.	520NW485 (5X5)	Unit 4 (20–24 ka)	L	dent.
64697	*Sylvilagus* sp.	580NW465	n/a	R	max
64711	*Sylvilagus* sp.	slumped area in trench	n/a	L	dent.
64722	*Sylvilagus* sp.	517NW515	n/a	L	dent.
64723	*Sylvilagus* sp.	slump	n/a	L	dent.
64723	*Sylvilagus* sp.	slump	n/a	n/a	max.
64725	*Sylvilagus* sp.	slump	n/a	R	dent.
64726	*Sylvilagus* sp.	slump	n/a	L	max
64727	*Sylvilagus* sp.	general collection screen cleanup	n/a	R	dent.
64728	*Sylvilagus* sp.	slump	n/a	L	dent.
64729	*Sylvilagus* sp.	517NW515	n/a	R	dent.
64734	*Sylvilagus* sp.	South end of trench slump	n/a	L	dent.
64753	*Sylvilagus* sp.	500NW450	Unit 1 (10–0 ka)	L	dent.
64755	*Sylvilagus* sp.	500NW450	Unit 1 (10–0 ka)	L	dent.
64756	*Sylvilagus* sp.	500NW450	Unit 1 (10–0 ka)	L	dent.
64757	*Sylvilagus* sp.	500NW450	n/a	L & R	max.
64760	*Sylvilagus* sp.	520NW495	Unit 1 (10–0 ka)	R	dent.
64761	*Sylvilagus* sp.	520NW495	Unit 1 (10–0 ka)	L	dent.

64764	*Sylvilagus* sp.	515NW485	n/a	L	dent.
64765	*Sylvilagus* sp.	520NW505	Unit 2 (12–14 ka)	R	dent.
64766	*Sylvilagus* sp.	520NW505	Unit 2 (12–14 ka)	R	dent.
64767	*Sylvilagus* sp.	520NW505	Unit 2 (12–14 ka)	L	dent.
64768	*Sylvilagus* sp.	520NW505	Unit 2 (12–14 ka)	L	dent.
64771	*Sylvilagus* sp.	520NW505	Unit 2 (12–14 ka)	L	dent.
64784	*Sylvilagus* sp.	525NW485	Unit 1 (10–0 ka)	L	dent.
64786	*Sylvilagus* sp.	510NW500	Unit 1 (10–0 ka)	L	dent.
64798	*Sylvilagus* sp.	no data	n/a	L	dent.
64811	*Sylvilagus* sp.	520NW500	Unit 2 (12–14 ka)	R	dent.
64812	*Sylvilagus* sp.	520NW500	Unit 2 (12–14 ka)	L	dent.
64813	*Sylvilagus* sp.	520NW500	Unit 2 (12–14 ka)	L	dent.
64827	*Sylvilagus* sp.	515NW485	Unit 2 (12–14 ka)	R	dent.
64828	*Sylvilagus* sp.	515NW485	Unit 2 (12–14 ka)	R	dent.
64831	*Sylvilagus* sp.	505NW485	Unit 2 (12–14 ka)	L	dent.
64832	*Sylvilagus* sp.	505NW485	Unit 2 (12–14 ka)		max.
64833	*Sylvilagus* sp.	505NW485	Unit 2 (12–14 ka)	L	dent.
64834	*Sylvilagus* sp.	505NW485	Unit 2 (12–14 ka)	L	dent.
64835	*Sylvilagus* sp.	505NW485	Unit 2 (12–14 ka)	R	dent.
67134	*Sylvilagus* sp.	505NW485	Unit 2 (12–14 ka)	R	dent.
67135	*Sylvilagus* sp.	505NW485	Unit 2 (12–14 ka)	R	dent.
67154	*Sylvilagus* sp.	n/a	n/a	L	dent.
67155	*Sylvilagus* sp.	no data	n/a	L	dent.
67157	*Sylvilagus* sp.	n/a	n/a	R	dent.
67909	*Sylvilagus* sp.	505NW485	Unit 1 (10–0 ka)	R	dent.
67921	*Sylvilagus* sp.	505NW485	Unit 1 (10–0 ka)	R	dent.
67951	*Sylvilagus* sp.	525NW485	Unit 1 (10–0 ka)		max.
68513	*Sylvilagus* sp.	510NW485	Unit 2 (12–14 ka)	R	dent.
68514	*Sylvilagus* sp.	510NW485	Unit 2 (12–14 ka)	L	dent.
68539	*Sylvilagus* sp.	510NW485	Unit 2 (12–14 ka)	L	dent.
68566	*Sylvilagus* sp.	510NW485	Unit 2 (12–14 ka)	L	dent.
71901	*Sylvilagus* sp.	505NW520	Unit 2 (12–14 ka)	L	dent.
97078	*Sylvilagus* sp.	n/a	n/a	L	dent.
97079	*Sylvilagus* sp.	no data	n/a	L	dent.
97145	*Sylvilagus* sp.	Trench	n/a	L	dent.
97267	*Sylvilagus* sp.	n/a	Unit 3 (17–20 ka)	L	dent.
97272	*Sylvilagus* sp.	slump	n/a	R	dent.
97290	*Sylvilagus* sp.	south end of trench	n/a	R	dent.
97399	*Sylvilagus* sp.	505NW485	Unit 2 (12–14 ka)	R	dent.
97465	*Sylvilagus* sp.	517NW515	n/a	R	dent.
97533	*Sylvilagus* sp.	slump	n/a	R	dent.
97534	*Sylvilagus* sp.	slump	n/a	R	dent.
97542	*Sylvilagus* sp.	slump	n/a	R	dent.
97593	*Sylvilagus* sp.	520NW505	Unit 1 (10–0 ka)	L	dent.
97599	*Sylvilagus* sp.	520NW505	Unit 1 (10–0 ka)	R	dent.
97614	*Sylvilagus* sp.	515NW485	Unit 2 (12–14 ka)	R	dent.
97641	*Sylvilagus* sp.	505NW500	n/a	L	dent.
97714	*Sylvilagus* sp.	slump	n/a	R	dent.
97723	*Sylvilagus* sp.	contiquous square	n/a	L	dent.
97806	*Sylvilagus* sp.	517NW515	Unit 1 (10–0 ka)	R	max

97821	*Sylvilagus* sp.	517NW515	Unit 2 (12–14 ka)	L	dent.
97828	*Sylvilagus* sp.	517NW515	Unit 1 (10–0 ka)	R	dent.
98087	*Sylvilagus* sp.	520NW505	Unit 1 (10–0 ka)	R	dent.
98106	*Sylvilagus* sp.	520NW505	Unit 1 (10–0 ka)	L	p3
123525	*Sylvilagus* sp.	500NW510	n/a	R	dent.
123527	*Sylvilagus* sp.	500NW510	n/a	L	dent.
123530	*Sylvilagus* sp.	500NW510	n/a	R	dent.
123531	*Sylvilagus* sp.	500NW510	n/a	R	dent.
124641	*Sylvilagus* sp.	505NW510	n/a	L	max
124643	*Sylvilagus* sp.	505NW510	n/a		max.
124661	*Sylvilagus* sp.	505NW510	n/a	R	dent.
124662	*Sylvilagus* sp.	505NW510	n/a	R	dent.
124663	*Sylvilagus* sp.	505NW510	n/a	R	dent.
124665	*Sylvilagus* sp.	505NW510	n/a	L	dent.
124666	*Sylvilagus* sp.	505NW510	n/a	L	dent.
124667	*Sylvilagus* sp.	505NW510	n/a	L	dent.
124673	*Sylvilagus* sp.	505NW510	n/a	R	p3
124674	*Sylvilagus* sp.	505NW510	n/a	R	p3
124675	*Sylvilagus* sp.	505NW510	n/a	L	p3
124676	*Sylvilagus* sp.	505NW510	n/a	R	P2
125294	*Sylvilagus* sp.	500NW510	Unit 3 (17–20 ka)	L	dent.
126953	*Sylvilagus* sp.	580NW465	n/a	L	dent.
126954	*Sylvilagus* sp.	500NW450	Unit 1 (10–0 ka)	R	dent.
126956	*Sylvilagus* sp.	540NW510	n/a	L	dent.
126984	*Sylvilagus* sp.	500NW450	Unit 1 (10–0 ka)	R	dent.
126986	*Sylvilagus* sp.	580NW465	n/a	L	dent.
141899	*Sylvilagus* sp.	500NW450	Unit 1 (10–0 ka)	L	dent.
141900	*Sylvilagus* sp.	500NW450	Unit 1 (10–0 ka)	L	dent.
141901	*Sylvilagus* sp.	500NW450	Unit 1 (10–0 ka)	L	dent.
141902	*Sylvilagus* sp.	517NW515	Unit 3 (17–20 ka)	L	dent.
147071	*Sylvilagus* sp.	500NW450	Unit 1 (10–0 ka)	L	p3
147712	*Sylvilagus* sp.	520NW485 (5X5)	Unit 4 (20–24 ka)	L	dent.
147713	*Sylvilagus* sp.	520NW510	Unit 2 (12–14 ka)	L	dent.
147714	*Sylvilagus* sp.	500NW450	Unit 1 (10–0 ka)	R	dent.
147715	*Sylvilagus* sp.	520NW505	Unit 2 (12–14 ka)	L	dent.
147716	*Sylvilagus* sp.	500NW515	n/a	R	dent.
147717	*Sylvilagus* sp.	520NW500	Unit 2 (12–14 ka)	L	dent.
147718	*Sylvilagus* sp.	520NW510	Unit 2 (12–14 ka)	L	dent.
147719	*Sylvilagus* sp.	500NW450	Unit 1 (10–0 ka)	R	dent.
147720	*Sylvilagus* sp.	500NW450	Unit 1 (10–0 ka)	L	dent.
147721	*Sylvilagus* sp.	515NW485	Unit 3 (17–20 ka)	R	dent.
147722	*Sylvilagus* sp.	slump	n/a	R	dent.
147729	*Sylvilagus* sp.	520NW500	Unit 2 (12–14 ka)	L	p3
147730	*Sylvilagus* sp.	520NW495	Unit 2 (12–14 ka)	R	dent.
147731	*Sylvilagus* sp.	n/a	n/a	L & R	dent.
147732	*Sylvilagus* sp.	500NW510	Unit 3 (17–20 ka)	L	p3
147737	*Sylvilagus* sp.	515NW485	Unit 1 (10–0 ka)	L	dent.
147751	*Sylvilagus* sp.	520NW505	Unit 1 (10–0 ka)	R	p3
147752	*Sylvilagus* sp.	520NW495	Unit 1 (10–0 ka)	L	dent.
147753	*Sylvilagus* sp.	520NW495	Unit 1 (10–0 ka)	R	dent.

147754	*Sylvilagus* sp.	520NW495	Unit 1 (10–0 ka)		max.
147755	*Sylvilagus* sp.	520NW495	Unit 1 (10–0 ka)	R	max.
147756	*Sylvilagus* sp.	505NW510	Unit 3 (17–20 ka)	R	dent.
147757	*Sylvilagus* sp.	520NW505	Unit 2 (12–14 ka)	L	dent.
147758	*Sylvilagus* sp.	515NW485	Unit 2 (12–14 ka)	L	dent.
147759	*Sylvilagus* sp.	500NW450	Unit 1 (10–0 ka)	L	dent.
147760	*Sylvilagus* sp.	520NW490	Unit 2 (12–14 ka)	L	dent.
147761	*Sylvilagus* sp.	520NW500	Unit 2 (12–14 ka)	L	dent.
147762	*Sylvilagus* sp.	520NW500	Unit 2 (12–14 ka)	L	dent.
147763	*Sylvilagus* sp.	520NW500	Unit 2 (12–14 ka)	R	dent.
147764	*Sylvilagus* sp.	520NW500	Unit 2 (12–14 ka)	R	dent.
147765	*Sylvilagus* sp.	540NW510	n/a	R	dent.
147766	*Sylvilagus* sp.	540NW510	n/a	R	dent.
147767	*Sylvilagus* sp.	520NW485	Unit 4 (20–24 ka)	R	dent.
147768	*Sylvilagus* sp.	500NW450	Unit 1 (10–0 ka)	L	dent.
147769	*Sylvilagus* sp.	500NW450	n/a	L	dent.
147770	*Sylvilagus* sp.	525NW485	Unit 2 (12–14 ka)	L	dent.
147771	*Sylvilagus* sp.	485-490NW515	Unit 5 (24–100 ka)	R	dent.
147772	*Sylvilagus* sp.	520NW505	Unit 1 (10–0 ka)	L	dent.
147773	*Sylvilagus* sp.	520NW515	Unit 1 (10–0 ka)	L	dent.
147774	*Sylvilagus* sp.	520NW495	Unit 1 (10–0 ka)	R	dent.
147775	*Sylvilagus* sp.	520NW495	Unit 1 (10–0 ka)	R	dent.
147776	*Sylvilagus* sp.	520NW495	Unit 1 (10–0 ka)	L	dent.
147777	*Sylvilagus* sp.	520NW495	Unit 1 (10–0 ka)	L	dent.
147778	*Sylvilagus* sp.	520NW490	Unit 1 (10–0 ka)	R	dent.
147779	*Sylvilagus* sp.	505NW485	Unit 2 (12–14 ka)	L	dent.
147780	*Sylvilagus* sp.	505NW485	Unit 2 (12–14 ka)	L	dent.
147781	*Sylvilagus* sp.	540NW510	n/a	L	dent.
147782	*Sylvilagus* sp.	540NW510	n/a	R	dent.
147783	*Sylvilagus* sp.	520NW505	Unit 2 (12–14 ka)	L	dent.
147784	*Sylvilagus* sp.	520NW505	Unit 2 (12–14 ka)	R	dent.
147785	*Sylvilagus* sp.	520NW505	Unit 2 (12–14 ka)	R	dent.
147786	*Sylvilagus* sp.	520NW505	Unit 2 (12–14 ka)	R	dent.
147787	*Sylvilagus* sp.	520NW510	Unit 2 (12–14 ka)	L	dent.
147788	*Sylvilagus* sp.	520NW505	Unit 2 (12–14 ka)	R	dent.
147789	*Sylvilagus* sp.	520NW505	Unit 2 (12–14 ka)	L	dent.
147790	*Sylvilagus* sp.	520NW505	Unit 2 (12–14 ka)	R	dent.
147791	*Sylvilagus* sp.	520NW505	Unit 2 (12–14 ka)	R	dent.
147792	*Sylvilagus* sp.	520NW505	Unit 2 (12–14 ka)	R	dent.
147793	*Sylvilagus* sp.	520NW505	Unit 2 (12–14 ka)	L	dent.
147794	*Sylvilagus* sp.	520NW505	Unit 2 (12–14 ka)	R	dent.
147795	*Sylvilagus* sp.	520NW505	Unit 2 (12–14 ka)	L	dent.
147796	*Sylvilagus* sp.	520NW505	Unit 2 (12–14 ka)	R	dent.
147797	*Sylvilagus* sp.	520NW505	Unit 2 (12–14 ka)	R	dent.
147798	*Sylvilagus* sp.	520NW505	Unit 2 (12–14 ka)	L	dent.
147799	*Sylvilagus* sp.	520NW505	Unit 2 (12–14 ka)	L	dent.
147800	*Sylvilagus* sp.	500NW450	Unit 1 (10–0 ka)	L	dent.
147801	*Sylvilagus* sp.	500NW450	Unit 1 (10–0 ka)	R	dent.
147802	*Sylvilagus* sp.	500NW450	Unit 1 (10–0 ka)	R	dent.
147803	*Sylvilagus* sp.	500NW450	Unit 1 (10–0 ka)	R	dent.

147804	*Sylvilagus* sp.	515NW485	Unit 3 (17–20 ka)	L	dent.
147805	*Sylvilagus* sp.	510NW515	n/a	L	dent.
147806	*Sylvilagus* sp.	510NW515	n/a	R	dent.
147807	*Sylvilagus* sp.	510NW515B	Unit 3 (17–20 ka)	R	dent.
147808	*Sylvilagus* sp.	520NW505	Unit 2 (12–14 ka)		max.
147813	*Sylvilagus* sp.	500NW450	Unit 1 (10–0 ka)	R	max
147814	*Sylvilagus* sp.	520NW490	Unit 2 (12–14 ka)	L	max
147815	*Sylvilagus* sp.	520NW505	Unit 2 (12–14 ka)	L	max
147816	*Sylvilagus* sp.	520NW505	Unit 2 (12–14 ka)	R	max
147817	*Sylvilagus* sp.	520NW505	Unit 1 (10–0 ka)	L	P2
147818	*Sylvilagus* sp.	520NW505	Unit 1 (10–0 ka)	R	p3
147820	*Sylvilagus* sp.	520NW490	Unit 2 (12–14 ka)	L	dent.
147821	*Sylvilagus* sp.	520NW495	Unit 2 (12–14 ka)	R	p3
147822	*Sylvilagus* sp.	520NW505	Unit 1 (10–0 ka)	L	max
147823	*Sylvilagus* sp.	520NW495	Unit 2 (12–14 ka)	L	dent.
147824	*Sylvilagus* sp.	520NW495	Unit 2 (12–14 ka)	R	dent.
147825	*Sylvilagus* sp.	520NW495	Unit 2 (12–14 ka)	L	dent.
147826	*Sylvilagus* sp.	500NW450	Unit 1 (10–0 ka)	R	dent.
147827	*Sylvilagus* sp.	520NW485 (5X5)	Unit 4 (20–24 ka)	L	dent.
147828	*Sylvilagus* sp.	520NW490	Unit 1 (10–0 ka)	R	dent.
147829	*Sylvilagus* sp.	500NW450	Unit 1 (10–0 ka)	R	dent.
147830	*Sylvilagus* sp.	520NW505	Unit 1 (10–0 ka)	R	dent.
147831	*Sylvilagus* sp.	520NW505	Unit 1 (10–0 ka)	R	dent.
147833	*Sylvilagus* sp.	520NW485 (5X5)	Unit 4 (20–24 ka)	R	dent.
147834	*Sylvilagus* sp.	520NW485 (5X5)	Unit 4 (20–24 ka)	R	dent.
147835	*Sylvilagus* sp.	520NW490	Unit 1 (10–0 ka)	R	dent.
147838	*Sylvilagus* sp.	525NW485	Unit 1 (10–0 ka)	R	max
147839	*Sylvilagus* sp.	520NW495	Unit 2 (12–14 ka)		max.
147840	*Sylvilagus* sp.	515NW485	Unit 3 (17–20 ka)		max.
147841	*Sylvilagus* sp.	520NW485 (5X5)	Unit 4 (20–24 ka)	R	p3
147842	*Sylvilagus* sp.	520NW490	Unit 1 (10–0 ka)	R	p3
147844	*Sylvilagus* sp.	517NW515	n/a	R	dent.
147846	*Sylvilagus* sp.	n/a	n/a	R	dent.
147847	*Sylvilagus* sp.	n/a	n/a	R	dent.
147848	*Sylvilagus* sp.	n/a	n/a	R	p3
147850	*Sylvilagus* sp.	525NW485	Unit 1 (10–0 ka)	R	max
147851	*Sylvilagus* sp.	n/a	n/a	L	P2
147852	*Sylvilagus* sp.	520NW505	Unit 2 (12–14 ka)	R	p3
147853	*Sylvilagus* sp.	510NW515	n/a	R	dent.
147855	*Sylvilagus* sp.	n/a	n/a	R	dent.
147856	*Sylvilagus* sp.	n/a	n/a	R	p3
147857	*Sylvilagus* sp.	520NW505	Unit 2 (12–14 ka)	L	dent.
147858	*Sylvilagus* sp.	517NW515	n/a	L	p3
147859	*Sylvilagus* sp.	n/a	n/a	R	dent.
147860	*Sylvilagus* sp.	n/a	n/a	R	p3
147861	*Sylvilagus* sp.	520NW505	Unit 2 (12–14 ka)	R	dent.
147862	*Sylvilagus* sp.	n/a	n/a	R	dent.
147865	*Sylvilagus* sp.	520NW505	Unit 2 (12–14 ka)	L	p3
147866	*Sylvilagus* sp.	520NW505	Unit 2 (12–14 ka)	L	p3
147867	*Sylvilagus* sp.	520NW505	Unit 2 (12–14 ka)	L	p3

147868	*Sylvilagus* sp.	520NW505	Unit 2 (12–14 ka)	R	p3
147869	*Sylvilagus* sp.	520NW505	Unit 2 (12–14 ka)		max.
147870	*Sylvilagus* sp.	520NW505	Unit 2 (12–14 ka)	R	P2
147871	*Sylvilagus* sp.	520NW505	Unit 2 (12–14 ka)	R	p3
147872	*Sylvilagus* sp.	517NW515	Unit 3 (17–20 ka)	L	dent.
147873	*Sylvilagus* sp.	505NW485	Unit 2 (12–14 ka)	L	P2
147874	*Sylvilagus* sp.	505NW485	Unit 2 (12–14 ka)	R	P2
147875	*Sylvilagus* sp.	lion's square	n/a	R	p3
147876	*Sylvilagus* sp.	520NW505	Unit 1 (10–0 ka)	L	p3
147877	*Sylvilagus* sp.	517NW515	Unit 3 (17–20 ka)	L	p3
147878	*Sylvilagus* sp.	500NW500	n/a	R	p3
147879	*Sylvilagus* sp.	500NW450	Unit 1 (10–0 ka)	L	p3
147880	*Sylvilagus* sp.	n/a	Unit 3 (17–20 ka)	L	p3
147881	*Sylvilagus* sp.	580NW465	n/a	L	p3
147882	*Sylvilagus* sp.	540NW510	n/a	L	p3
147884	*Sylvilagus* sp.	500NW515	Unit 3 (17–20 ka)	L	p3
147885	*Sylvilagus* sp.	517NW515	Unit 3 (17–20 ka)	R	p3
147886	*Sylvilagus* sp.	n/a	Unit 1 (10–0 ka)	R	dent.
147887	*Sylvilagus* sp.	n/a	Unit 1 (10–0 ka)	R	dent.
147888	*Sylvilagus* sp.	580NW465	n/a	L	dent.
147889	*Sylvilagus* sp.	580NW465	n/a	L	dent.
147890	*Sylvilagus* sp.	510NW500	n/a	R	dent.
147891	*Sylvilagus* sp.	580NW465	n/a	R	max
147892	*Sylvilagus* sp.	580NW465	n/a	R	P2
147893	*Sylvilagus* sp.	520NW510	Unit 2 (12–14 ka)	R	dent.
147894	*Sylvilagus* sp.	500NW515	n/a	R	dent.
147895	*Sylvilagus* sp.	520NW505	Unit 2 (12–14 ka)	L	dent.
147896	*Sylvilagus* sp.	520NW505	Unit 2 (12–14 ka)	L	max
147897	*Sylvilagus* sp.	520NW505	Unit 2 (12–14 ka)	R	P2
147898	*Sylvilagus* sp.	500NW515	n/a	L	p3
147899	*Sylvilagus* sp.	525NW485	Unit 1 (10–0 ka)	L	dent.
147900	*Sylvilagus* sp.	515NW485	Unit 1 (10–0 ka)	L	p3
147904	*Sylvilagus* sp.	lion's square	n/a	R	p3
147905	*Sylvilagus* sp.	515NW485	Unit 1 (10–0 ka)	L	dent.
147906	*Sylvilagus* sp.	520NW505	Unit 2 (12–14 ka)	L	p3
147907	*Sylvilagus* sp.	520NW505	Unit 2 (12–14 ka)	L	p3
147908	*Sylvilagus* sp.	520NW505	Unit 2 (12–14 ka)	L	p3
147909	*Sylvilagus* sp.	520NW505	Unit 2 (12–14 ka)	L	p3
147910	*Sylvilagus* sp.	520NW505	Unit 2 (12–14 ka)	R	p3
147911	*Sylvilagus* sp.	520NW505	Unit 2 (12–14 ka)	R	p3
147912	*Sylvilagus* sp.	520NW505	Unit 2 (12–14 ka)	R	p3
147914	*Sylvilagus* sp.	505NW485	Unit 2 (12–14 ka)	L	dent.
147915	*Sylvilagus* sp.	520NW505	Unit 2 (12–14 ka)	R	dent.
147916	*Sylvilagus* sp.	510NW515	n/a	L	p3
147917	*Sylvilagus* sp.	510NW515	n/a	L	p3
147918	*Sylvilagus* sp.	510NW515	n/a	R	p3
147920	*Sylvilagus* sp.	520NW505	Unit 2 (12–14 ka)	R	dent.
147921	*Sylvilagus* sp.	525NW485	Unit 1 (10–0 ka)	L	P2
147922	*Sylvilagus* sp.	525NW485	Unit 1 (10–0 ka)	L	p3
147923	*Sylvilagus* sp.	520NW505	Unit 2 (12–14 ka)	R	dent.

147924	*Sylvilagus* sp.	520NW505	Unit 2 (12–14 ka)	R	dent.
147925	*Sylvilagus* sp.	520NW505	Unit 2 (12–14 ka)	R	dent.
147926	*Sylvilagus* sp.	520NW505	Unit 2 (12–14 ka)	R	dent.
147927	*Sylvilagus* sp.	520NW505	Unit 2 (12–14 ka)	R	dent.
147928	*Sylvilagus* sp.	520NW505	Unit 2 (12–14 ka)	L	dent.
147929	*Sylvilagus* sp.	520NW505	Unit 2 (12–14 ka)	R	dent.
147930	*Sylvilagus* sp.	520NW505	Unit 2 (12–14 ka)	R	dent.
147931	*Sylvilagus* sp.	520NW505	Unit 2 (12–14 ka)	L	dent.
147932	*Sylvilagus* sp.	520NW505	Unit 2 (12–14 ka)	L	dent.
147933	*Sylvilagus* sp.	520NW505	Unit 2 (12–14 ka)	L	dent.
147934	*Sylvilagus* sp.	520NW505	Unit 2 (12–14 ka)	L	dent.
147950	*Sylvilagus* sp.	520NW495	Unit 2 (12–14 ka)	L	p3
147951	*Sylvilagus* sp.	520NW505	Unit 2 (12–14 ka)	R	p3
147952	*Sylvilagus* sp.	495-500NW515	Unit 6 (>100 ka)	L	p3
147953	*Sylvilagus* sp.	510N	Unit 6 (>100 ka)	L	P2
147954	*Sylvilagus* sp.	500NW505	Unit 6 (>100 ka)	R	P2
148212	*Sylvilagus* sp.	510NW500	n/a	L	dent.
148214	*Sylvilagus* sp.	510NW500	n/a	R	dent.
148215	*Sylvilagus* sp.	510NW500	n/a	R	dent.
148216	*Sylvilagus* sp.	510NW500	n/a	R	dent.
148239	*Sylvilagus* sp.	505NW485	Unit 2 (12–14 ka)	L	dent.
148242	*Sylvilagus* sp.	505NW485	Unit 2 (12–14 ka)	L	p3
148243	*Sylvilagus* sp.	505NW485	Unit 2 (12–14 ka)	R	max
148244	*Sylvilagus* sp.	505NW485	Unit 2 (12–14 ka)	R	p3
148250	*Sylvilagus* sp.	510NW500	Unit 1 (10–0 ka)	R	dent.
148258	*Sylvilagus* sp.	505NW485	Unit 2 (12–14 ka)	L	p3
148259	*Sylvilagus* sp.	505NW485	Unit 2 (12–14 ka)	L	p3
148260	*Sylvilagus* sp.	505NW485	Unit 2 (12–14 ka)	R	max
148261	*Sylvilagus* sp.	505NW485	Unit 2 (12–14 ka)	L & R	max.
148262	*Sylvilagus* sp.	505NW485	Unit 2 (12–14 ka)	L	dent.
148263	*Sylvilagus* sp.	505NW485	Unit 2 (12–14 ka)	L	dent.
148264	*Sylvilagus* sp.	505NW485	Unit 2 (12–14 ka)	L	dent.
148265	*Sylvilagus* sp.	505NW485	Unit 2 (12–14 ka)	R	dent.
148266	*Sylvilagus* sp.	505NW485	Unit 2 (12–14 ka)	L	dent.
148267	*Sylvilagus* sp.	505NW485	Unit 2 (12–14 ka)	L & R	max.
148272	*Sylvilagus* sp.	517NW515	Unit 3 (17–20 ka)	R	dent.
148273	*Sylvilagus* sp.	517NW515	Unit 3 (17–20 ka)	R	p3
148282	*Sylvilagus* sp.	495NW510	n/a	L	dent.
148283	*Sylvilagus* sp.	495NW510	n/a	R	p3
148285	*Sylvilagus* sp.	495NW510	n/a	L	dent.
148290	*Sylvilagus* sp.	520NW500	Unit 2 (12–14 ka)	L	dent.
148291	*Sylvilagus* sp.	510NW500	Unit 1 (10–0 ka)	R	p3
148294	*Sylvilagus* sp.	580NW465	n/a	R	max
148295	*Sylvilagus* sp.	580NW465	n/a	R	max
148296	*Sylvilagus* sp.	580NW465	n/a	L	max
148297	*Sylvilagus* sp.	580NW465	n/a	L	max
148306	*Sylvilagus* sp.	495NW510	n/a	R	dent.
148309	*Sylvilagus* sp.	495NW510	n/a	L	dent.
148310	*Sylvilagus* sp.	495NW510	n/a	R	max
148311	*Sylvilagus* sp.	495NW510	n/a	L & R	max

148312	*Sylvilagus* sp.	480NW515	Unit 1 (10–0 ka)	L	dent.
148313	*Sylvilagus* sp.	480NW515	Unit 1 (10–0 ka)	L	p3
148317	*Sylvilagus* sp.	495NW515	n/a	L	dent.
148318	*Sylvilagus* sp.	495NW515	n/a	L	dent.
148320	*Sylvilagus* sp.	520NW520	Unit 3 (17–20 ka)	L	dent.
148333	*Sylvilagus* sp.	510NW485	Unit 2 (12–14 ka)	L	P2
148334	*Sylvilagus* sp.	510NW485	Unit 2 (12–14 ka)	L	p3
148335	*Sylvilagus* sp.	510NW485	Unit 2 (12–14 ka)	L	p3
148336	*Sylvilagus* sp.	510NW485	Unit 2 (12–14 ka)	L	p3
148337	*Sylvilagus* sp.	510NW485	Unit 2 (12–14 ka)	L	dent.
148338	*Sylvilagus* sp.	510NW485	Unit 2 (12–14 ka)	R	dent.
148339	*Sylvilagus* sp.	510NW485	Unit 2 (12–14 ka)	R	dent.
148340	*Sylvilagus* sp.	510NW485	Unit 2 (12–14 ka)	R	dent.
148342	*Sylvilagus* sp.	510NW485	Unit 2 (12–14 ka)	L & R	max
148343	*Sylvilagus* sp.	510NW485	Unit 2 (12–14 ka)	L	max
148354	*Sylvilagus* sp.	510NW485	Unit 2 (12–14 ka)	L	max
148357	*Sylvilagus* sp.	510NW485	Unit 2 (12–14 ka)	L	dent.
148362	*Sylvilagus* sp.	510NW485	Unit 2 (12–14 ka)	L	max
148363	*Sylvilagus* sp.	510NW485	Unit 2 (12–14 ka)	L	max
148364	*Sylvilagus* sp.	510NW485	Unit 2 (12–14 ka)	L	dent.
148365	*Sylvilagus* sp.	510NW485	Unit 2 (12–14 ka)	L	p3
148371	*Sylvilagus* sp.	480NW500	n/a	R	dent.
148373	*Sylvilagus* sp.	510NW485	Unit 2 (12–14 ka)	L	dent.
148375	*Sylvilagus* sp.	485NW505	Unit 1 (10–0 ka)	L	p3
148388	*Sylvilagus* sp.	485NW505	Unit 1 (10–0 ka)	R	dent.
148404	*Sylvilagus* sp.	520NW505	Unit 2 (12–14 ka)	R	dent.
148425	*Sylvilagus* sp.	520NW505	Unit 2 (12–14 ka)	R	dent.
148829	*Sylvilagus* sp.	505NW525	Unit 3 (17–20 ka)	R	P2
148830	*Sylvilagus* sp.	495NW515	Unit 3 (17–20 ka)	R	p3
148831	*Sylvilagus* sp.	505NW515	n/a	R	P2
148832	*Sylvilagus* sp.	505NW520	Unit 3 (17–20 ka)	L	P2
148833	*Sylvilagus* sp.	505NW515	n/a	R	p3
148834	*Sylvilagus* sp.	505NW515	n/a	R	p3
148835	*Sylvilagus* sp.	500NW515	n/a	R	p3
148836	*Sylvilagus* sp.	505NW525	Unit 3 (17–20 ka)	L	P2
148837	*Sylvilagus* sp.	495NW515	n/a	L	p3
148838	*Sylvilagus* sp.	495NW515	n/a	R	p3
148839	*Sylvilagus* sp.	580NW465	n/a	R	P2
148840	*Sylvilagus* sp.	580NW465	n/a	L	dent.
148841	*Sylvilagus* sp.	495NW515	n/a	L	P2
148842	*Sylvilagus* sp.	520NW510	Unit 1 (10–0 ka)	R	p3
148843	*Sylvilagus* sp.	495NW515	n/a	R	p3
148844	*Sylvilagus* sp.	520NW510	Unit 1 (10–0 ka)	R	dent.
148845	*Sylvilagus* sp.	510NW515B	Unit 3 (17–20 ka)	L	P2
148856	*Sylvilagus* sp.	520NW510	Unit 2 (12–14 ka)	L	p3
148857	*Sylvilagus* sp.	505NW515	Unit 3 (17–20 ka)	L	P2
148858	*Sylvilagus* sp.	520NW525	Unit 3 (17–20 ka)	R	p3
148859	*Sylvilagus* sp.	580NW465	n/a	L	dent.
148860	*Sylvilagus* sp.	505NW515	Unit 3 (17–20 ka)	L	P2
148861	*Sylvilagus* sp.	500NW515	Unit 1 (10–0 ka)	R	P2

148862	*Sylvilagus* sp.	580NW465	n/a	L	p3
148863	*Sylvilagus* sp.	520NW510	Unit 1 (10–0 ka)	R	p3
148864	*Sylvilagus* sp.	520NW525	Unit 1 (10–0 ka)	R	dent.
148865	*Sylvilagus* sp.	520NW490	Unit 2 (12–14 ka)	L	p3
148866	*Sylvilagus* sp.	500NW515	Unit 6 (>100 ka)	L	p3
148867	*Sylvilagus* sp.	520NW490	Unit 2 (12–14 ka)	R	P2
148868	*Sylvilagus* sp.	495NW515	n/a	L	p3
148869	*Sylvilagus* sp.	520NW490	Unit 1 (10–0 ka)	L	p3
148870	*Sylvilagus* sp.	520NW490	Unit 3 (17–20 ka)	R	max
148871	*Sylvilagus* sp.	520NW490	Unit 2 (12–14 ka)	R	P2
148872	*Sylvilagus* sp.	520NW490	Unit 3 (17–20 ka)	L	dent.
148873	*Sylvilagus* sp.	505NW515	n/a	R	p3
148874	*Sylvilagus* sp.	495NW515	n/a	R	P2
148875	*Sylvilagus* sp.	500NW515	n/a	L	p3
148876	*Sylvilagus* sp.	520NW490	Unit 1 (10–0 ka)	L	P2
148877	*Sylvilagus* sp.	520NW490	Unit 2 (12–14 ka)	L	P2
148878	*Sylvilagus* sp.	580NW465	n/a	R	dent.
148879	*Sylvilagus* sp.	580NW465	n/a	R	dent.
148880	*Sylvilagus* sp.	580NW465	n/a	L	dent.
149276	*Sylvilagus* sp.	505NW485	Unit 2 (12–14 ka)	R	dent.
149278	*Sylvilagus* sp.	510NW485	Unit 2 (12–14 ka)	R	dent.
149279	*Sylvilagus* sp.	510NW485	Unit 2 (12–14 ka)	R	max
149280	*Sylvilagus* sp.	520NW520	Unit 3 (17–20 ka)	L	P2
149281	*Sylvilagus* sp.	520NW520	Unit 3 (17–20 ka)	R	P2
149282	*Sylvilagus* sp.	520NW505	Unit 2 (12–14 ka)	R	dent.
149283	*Sylvilagus* sp.	wall clean up	Unit 3 (17–20 ka)	L	max
149284	*Sylvilagus* sp.	520NW505	Unit 2 (12–14 ka)	R	max
149285	*Sylvilagus* sp.	520NW505	Unit 2 (12–14 ka)	R	max
149286	*Sylvilagus* sp.	520NW505	Unit 2 (12–14 ka)	R	max
149348	*Sylvilagus* sp.	510N	Unit 6 (>100 ka)	L	P2
149382	*Sylvilagus* sp.	540NW510	n/a	L	dent.
64816	*Sylvilagus* cf. *audubonii*	580NW465	possibly Unit 1 or 2	n/a	skull
26275	*Lepus* sp.	510NW500	n/a	R	dent.
26380	*Lepus* sp.	540NW510	n/a	L	dent.
27519	*Lepus* sp.	580NW465	n/a	n/a	skull
42729	*Lepus* sp.	505NW535	Unit 3 (17–20 ka)	R	dent.
42755	*Lepus* sp.	505NW525	Unit 3 (17–20 ka)	L	p3
64737	*Lepus* sp.	505NW535	Unit 3 (17–20 ka)	n/a	skull
64805	*Lepus* sp.	520NW490	Unit 3 (17–20 ka)	R	dent.
64806	*Lepus* sp.	505NW500	n/a	R	dent.
64807	*Lepus* sp.	515NW485	Unit 2 (12–14 ka)	R	dent.
64817	*Lepus* sp.	505NW485	Unit 2 (12–14 ka)	R	dent.
64830	*Lepus* sp.	505NW485	Unit 2 (12–14 ka)	R	dent.
68560	*Lepus* sp.	510NW485	Unit 2 (12–14 ka)	L	dent.
68565	*Lepus* sp.	510NW485	Unit 2 (12–14 ka)	R	dent.
97219	*Lepus* sp.	515NW485	Unit 2 (12–14 ka)	R	dent.
97302	*Lepus* sp.	slump	n/a	L	P2
97354	*Lepus* sp.	505NW500	Unit 1 (10–0 ka)	R	dent.
123555	*Lepus* sp.	500NW510	n/a	R	max
124660	*Lepus* sp.	505NW510	n/a	R	dent.

124672	*Lepus* sp.	505NW510	n/a	L	p3
126808	*Lepus* sp.	505NW485	Unit 1 (10–0 ka)	R	dent.
126985	*Lepus* sp.	540NW510	n/a	R	dent.
147723	*Lepus* sp.	520NW490	Unit 2 (12–14 ka)	R	dent.
147724	*Lepus* sp.	510NW505	Unit 6 (>100 ka)	R	dent.
147725	*Lepus* sp.	510NW505	Unit 6 (>100 ka)	R	dent.
147726	*Lepus* sp.	510NW505	Unit 6 (>100 ka)	R	dent.
147727	*Lepus* sp.	500NW500 or 505NW500	n/a	R	p3
147728	*Lepus* sp.	510NW505	Unit 6 (>100 ka)	L	p3
147733	*Lepus* sp.	515NW485	Unit 3 (17–20 ka)	R	dent.
147734	*Lepus* sp.	510NW505	n/a	L	dent.
147735	*Lepus* sp.	520NW490	Unit 2 (12–14 ka)	R	dent.
147736	*Lepus* sp.	525NW485	Unit 1 (10–0 ka)	R	dent.
147738	*Lepus* sp.	505NW505	n/a	R	p3
147739	*Lepus* sp.	505NW505	n/a	L	dent.
147740	*Lepus* sp.	505NW505	n/a	L	p3
147741	*Lepus* sp.	505NW515?	Unit 6 (>100 ka)	R	p3
147742	*Lepus* sp.	510NW505	n/a	R	max
147743	*Lepus* sp.	510NW505	Unit 6 (>100 ka)	R	max
147744	*Lepus* sp.	510NW505	Unit 6 (>100 ka)	R	p3
147745	*Lepus* sp.	510NW505	n/a	L	dent.
147746	*Lepus* sp.	510NW505	n/a	L	dent.
147747	*Lepus* sp.	510NW505	n/a	L	max
147748	*Lepus* sp.	510NW505	n/a	n/a	max.
147749	*Lepus* sp.	510NW505	Unit 6 (>100 ka)	R	max
147750	*Lepus* sp.	510N	Unit 6 (>100 ka)	R	p3
147809	*Lepus* sp.	520NW505	Unit 2 (12–14 ka)	L	max
147810	*Lepus* sp.	510NW505	Unit 6 (>100 ka)	R	max
147811	*Lepus* sp.	510NW505	Unit 6 (>100 ka)	L	max
147812	*Lepus* sp.	510NW505	Unit 6 (>100 ka)	L	max
147832	*Lepus* sp.	517NW515	Unit 2 (12–14 ka)	R	dent.
147836	*Lepus* sp.	510NW505	Unit 6 (>100 ka)	R	dent.
147837	*Lepus* sp.	510NW505	Unit 6 (>100 ka)	R	dent.
147849	*Lepus* sp.	Contiguous square	n/a	R	p3
147854	*Lepus* sp.	n/a	n/a	L	p3
147863	*Lepus* sp.	495-500NW515	Unit 6 (>100 ka)	R	max
147913	*Lepus* sp.	505NW485	Unit 2 (12–14 ka)	R	p3
147935	*Lepus* sp.	505NW505	Unit 6 (>100 ka)	L	p3
147937	*Lepus* sp.	510NW505	Unit 6 (>100 ka)	L	p3
148238	*Lepus* sp.	505NW485	Unit 2 (12–14 ka)	R	dent.
148281	*Lepus* sp.	495NW510	n/a	R	dent.
148284	*Lepus* sp.	495NW510	n/a	L	max
148293	*Lepus* sp.	580NW465	n/a	R	max
148305	*Lepus* sp.	495NW510	n/a	R	dent.
148319	*Lepus* sp.	520NW520	Unit 3 (17–20 ka)	L & R	max
148341	*Lepus* sp.	510NW485	Unit 2 (12–14 ka)	R	dent.
148356	*Lepus* sp.	510NW485	Unit 2 (12–14 ka)	L	dent.
148376	*Lepus* sp.	485NW505	Unit 1 (10–0 ka)	L	dent.
148396	*Lepus* sp.	510NW505	Unit 6 (>100 ka)	R	max
148397	*Lepus* sp.	510NW505	Unit 6 (>100 ka)	R	max

148403	*Lepus* sp.	510NW505	Unit 6 (>100 ka)	L	max
148424	*Lepus* sp.	520NW505	Unit 2 (12–14 ka)	L	P2
148815	*Lepus* sp.	500NW520	Unit 3 (17–20 ka)	L	p3
148816	*Lepus* sp.	580NW465	n/a	R	P2
148817	*Lepus* sp.	510NW515B	Unit 5 (24–100 ka)	R	p3
148818	*Lepus* sp.	510NW515B	Unit 5 (24–100 ka)	L	p3
148819	*Lepus* sp.	500NW520	Unit 1 (10–0 ka)	L	p3
149274	*Lepus* sp.	517NW515	Unit 1 (10–0 ka)	R	p3
67908	*Lepus arcticus*	505NW485	Unit 2 (12–14 ka)	L	dent.
36786	*Lepus arcticus*	525NW485	Unit 3 (17–20 ka)	L	premax
97117	*Lepus californicus*	n/a	n/a	L	p3
147936	*Lepus californicus*	500NW450	Unit 1 (10–0 ka)	R	p3

Appendix 1.4. Sciuridae

Cat. #	ID	Square	Unit	Side	element	dentition
149056	Marmotini sp. 1	510NW515A	Unit 3 (17–20 ka)	L	P3	
149070	Marmotini sp. 1	510NW515A	Unit 5 (24–100 ka)	L	m1	
149073	Marmotini sp. 1	505NW525	Unit 4 (20–24 ka)	L	m1	
149082	Marmotini sp. 1	495NW515	Unit 3 (17–20 ka)	R	P3	
149083	Marmotini sp. 1	510NW515A	Unit 4 (20–24 ka)	R	dent.	
149086	Marmotini sp. 1	510NW515	Unit 4 (20–24 ka)	R	P3	
149089	Marmotini sp. 1	505NW525	Unit 4 (20–24 ka)	L	P3	
149113	Marmotini sp. 1	495NW520	Unit 3 (17–20 ka)	R	m2	
149115	Marmotini sp. 1	505NW525	Unit 4 (20–24 ka)	R	m2	
149118	Marmotini sp. 1	505NW515	Unit 3 (17–20 ka)	L	m2	
149120	Marmotini sp. 1	495NW520	Unit 3 (17–20 ka)	L	m2	
149126	Marmotini sp. 1	505NW520	Unit 2 (12–14 ka)	L	m2	
149131	Marmotini sp. 1	495NW520	Unit 3 (17–20 ka)	R	m2	
149138	Marmotini sp. 1	500NW520	Unit 3 (17–20 ka)	L	m2	
149144	Marmotini sp. 1	500NW520	Unit 3 (17–20 ka)	L	m1	
149145	Marmotini sp. 1	500NW535	Unit 3 (17–20 ka)	L	m1	
149147	Marmotini sp. 1	500NW515	Unit 3 (17–20 ka)	R	m1	
149148	Marmotini sp. 1	495NW515	mixed Unit 1 & 2	R	m1	
149149	Marmotini sp. 1	505NW525	Unit 3 (17–20 ka)	L	m1	
149150	Marmotini sp. 1	500NW520	Unit 3 (17–20 ka)	R	m1	
149152	Marmotini sp. 1	495NW520	Unit 2 (12–14 ka)	L	m1	
149154	Marmotini sp. 1	500NW520	Unit 3 (17–20 ka)	R	m1	
149156	Marmotini sp. 1	500NW535	Unit 3 (17–20 ka)	R	m1	
149157	Marmotini sp. 1	495NW520	Unit 3 (17–20 ka)	R	m1	
149264	Marmotini sp. 1	500NW520	Unit 3 (17–20 ka)	R	P3	
149265	Marmotini sp. 1	495NW520	Unit 3 (17–20 ka)	R	P3	
149266	Marmotini sp. 1	500NW520	Unit 2 (12–14 ka)	R	P3	
149267	Marmotini sp. 1	505NW520	Unit 3 (17–20 ka)	R	P3	
149268	Marmotini sp. 1	500NW520	Unit 3 (17–20 ka)	R	P3	
149269	Marmotini sp. 1	505NW515	Unit 3 (17–20 ka)	R	P3	
149270	Marmotini sp. 1	505NW515	Unit 3 (17–20 ka)	R	P3	
149271	Marmotini sp. 1	495NW520	Unit 3 (17–20 ka)	R	P3	
149272	Marmotini sp. 1	505NW520	Unit 3 (17–20 ka)	L	P3	
149344	Marmotini sp. 1	510NW505	Unit 6 (>100 ka)	R	M3	
147046	*Urocitellus* sp.	505NW505	Unit 6 (>100 ka)	L	M 1/2	
149053	*Urocitellus* sp.	505NW525	Unit 3 (17–20 ka)	R	M 1/2	
149057	*Urocitellus* sp.	510NW515A	Unit 3 (17–20 ka)	L	M 1/2	
149122	*Urocitellus* sp.	500NW515	Unit 3 (17–20 ka)	L	M 1/2	
149197	*Urocitellus* sp.	510NW515	Unit 4 (20–24 ka)	R	M 1/2	
149198	*Urocitellus* sp.	505NW520	Unit 3 (17–20 ka)	L	M 1/2	
149199	*Urocitellus* sp.	500NW515	Unit 3 (17–20 ka)	L	M 1/2	
149200	*Urocitellus* sp.	495NW515	Unit 3 (17–20 ka)	L	M 1/2	
149201	*Urocitellus* sp.	505NW525	Unit 4 (20–24 ka)	R	M 1/2	
149202	*Urocitellus* sp.	505NW525	Unit 3 (17–20 ka)	R	M 1/2	
149203	*Urocitellus* sp.	500NW515	Unit 3 (17–20 ka)	L	M 1/2	
149204	*Urocitellus* sp.	495NW515	Unit 3 (17–20 ka)	L	M 1/2	
149205	*Urocitellus* sp.	495NW515	Unit 3 (17–20 ka)	R	M 1/2	

149206	*Urocitellus* sp.	505NW525	Unit 4 (20–24 ka)	R	M 1/2
149207	*Urocitellus* sp.	515NW520	Unit 1 or 2	R	M 1/2
149208	*Urocitellus* sp.	515NW520	Unit 3 (17–20 ka)	R	M 1/2
149209	*Urocitellus* sp.	515NW520	Unit 3 (17–20 ka)	R	M 1/2
149210	*Urocitellus* sp.	495NW515	Unit 3 (17–20 ka)	R	M 1/2
149211	*Urocitellus* sp.	505NW530	Unit 3 (17–20 ka)	L	M 1/2
149212	*Urocitellus* sp.	505NW515	Unit 3 (17–20 ka)	R	M 1/2
149213	*Urocitellus* sp.	505NW520	Unit 3 (17–20 ka)	R	M 1/2
149214	*Urocitellus* sp.	505NW525	Unit 4 (20–24 ka)	R	M 1/2
149215	*Urocitellus* sp.	500NW520	Unit 3 (17–20 ka)	R	M 1/2
149216	*Urocitellus* sp.	505NW525	Unit 4 (20–24 ka)	L	M 1/2
149217	*Urocitellus* sp.	515NW520	Unit 3 (17–20 ka)	R	M 1/2
149218	*Urocitellus* sp.	505NW520	Unit 3 (17–20 ka)	L	M 1/2
149219	*Urocitellus* sp.	505NW525	Unit 4 (20–24 ka)	L	M 1/2
149220	*Urocitellus* sp.	500NW515	Unit 3 (17–20 ka)	R	M 1/2
149221	*Urocitellus* sp.	500NW520	Unit 3 (17–20 ka)	L	M 1/2
149222	*Urocitellus* sp.	495NW515	mixed Unit 1 & 2	L	M 1/2
149223	*Urocitellus* sp.	505NW515	Unit 3 (17–20 ka)	L	M 1/2
149224	*Urocitellus* sp.	515NW520	Unit 3 (17–20 ka)	R	M 1/2
149225	*Urocitellus* sp.	505NW515	Unit 3 (17–20 ka)	L	M 1/2
149226	*Urocitellus* sp.	505NW520	Unit 3 (17–20 ka)	R	M 1/2
149227	*Urocitellus* sp.	495NW520	Unit 3 (17–20 ka)	L	M 1/2
149228	*Urocitellus* sp.	500NW515	mixed Unit 1 & 2	R	M 1/2
149229	*Urocitellus* sp.	505NW515	Unit 3 (17–20 ka)	L	M 1/2
149230	*Urocitellus* sp.	505NW530	Unit 3 (17–20 ka)	L	M 1/2
149231	*Urocitellus* sp.	505NW525	Unit 4 (20–24 ka)	L	M 1/2
149232	*Urocitellus* sp.	495NW515	Unit 3 (17–20 ka)	L	M 1/2
149233	*Urocitellus* sp.	495NW515	Unit 3 (17–20 ka)	R	M 1/2
149234	*Urocitellus* sp.	505NW525	Unit 4 (20–24 ka)	R	M 1/2
149235	*Urocitellus* sp.	505NW535	Unit 3 (17–20 ka)	R	M 1/2
149236	*Urocitellus* sp.	505NW515	mixed Unit 1 & 2	L	M 1/2
149237	*Urocitellus* sp.	505NW515	Unit 3 (17–20 ka)	L	M 1/2
149238	*Urocitellus* sp.	515NW520	Unit 3 (17–20 ka)	R	M 1/2
149239	*Urocitellus* sp.	500NW520	Unit 3 (17–20 ka)	R	M 1/2
149240	*Urocitellus* sp.	505NW515	Unit 3 (17–20 ka)	L	M 1/2
149241	*Urocitellus* sp.	505NW515	Unit 3 (17–20 ka)	R	M 1/2
149242	*Urocitellus* sp.	505NW525	Unit 4 (20–24 ka)	L	M 1/2
149243	*Urocitellus* sp.	495NW520	Unit 3 (17–20 ka)	L	M 1/2
149244	*Urocitellus* sp.	500NW515	Unit 3 (17–20 ka)	L	M 1/2
149246	*Urocitellus* sp.	505NW525	Unit 3 (17–20 ka)	R	M 1/2
149247	*Urocitellus* sp.	505NW525	Unit 4 (20–24 ka)	L	M 1/2
149248	*Urocitellus* sp.	505NW515	mixed Unit 1 & 2	R	M 1/2
149249	*Urocitellus* sp.	500NW520	Unit 3 (17–20 ka)	L	M 1/2
149250	*Urocitellus* sp.	505NW525	Unit 4 (20–24 ka)	L	M 1/2
149251	*Urocitellus* sp.	495NW515	Unit 3 (17–20 ka)	R	M 1/2
64658	*Urocitellus* sp.	480NW515	possibly Unit 2	L	M1 or M2
145142	*Urocitellus* sp.	510NW505	possibly Unit 6	L	M3
147044	*Urocitellus* sp.	505NW505	Unit 6 (>100 ka)	L	M3
145141	*Urocitellus* sp.	510NW505	Unit 6 (>100 ka)	R	m1
147047	*Urocitellus* sp.	510NW505	possibly Unit 6	R	m1

148209	*Urocitellus* sp.	480NW515	possibly Unit 2	R	M1 or M2
48935	*Urocitellus* sp.	517NW515	Unit 3 (17–20 ka)	R	m1-2
147068	*Urocitellus* sp.	510NW505	Unit 6 (>100 ka)	R	P4
147045	*Urocitellus* sp.	510NW505	Unit 6 (>100 ka)	R	P4
149058	*Urocitellus* sp.	510NW515A	Unit 3 (17–20 ka)	L	P4
149059	*Urocitellus* sp.	520NW525	Unit 3 (17–20 ka)	R	P4
149060	*Urocitellus* sp.	495NW515	Unit 4 (20–24 ka)	R	P4
149062	*Urocitellus* sp.	495NW515	Unit 4 (20–24 ka)	L	M 1/2
149063	*Urocitellus* sp.	510NW515A	Unit 5 (24–100 ka)	R	m2
149064	*Urocitellus* sp.	510NW515B	Unit 5 (24–100 ka)	L	M 1/2
149065	*Urocitellus* sp.	505NW515	Unit 3 (17–20 ka)	L	M 1/2
149066	*Urocitellus* sp.	520NW525	Unit 2 (12–14 ka)	R	M 1/2
149067	*Urocitellus* sp.	510NW515	Unit 5 (24–100 ka)	L	M 1/2
149068	*Urocitellus* sp.	510NW515	Unit 5 (24–100 ka)	L	M 1/2
149069	*Urocitellus* sp.	500NW515	Unit 3 (17–20 ka)	L	M 1/2
149071	*Urocitellus* sp.	510NW515	Unit 3 (17–20 ka)	L	m2
149072	*Urocitellus* sp.	510NW515B	Unit 3 (17–20 ka)	L	m2
42535	*Urocitellus* sp.	no data	no data	R	M 1/2
42534	*Urocitellus* sp.	n/a	Unit 3 (17–20 ka)	R	M 1/2
149075	*Urocitellus* sp.	495NW515	Unit 3 (17–20 ka)	L	m1
149076	*Urocitellus* sp.	495NW515	Unit 3 (17–20 ka)	L	m2
149078	*Urocitellus* sp.	500NW520	Unit 3 (17–20 ka)	R	m2
149081	*Urocitellus* sp.	510NW515B	Unit 5 (24–100 ka)	R	m3
149087	*Urocitellus* sp.	510NW515B	Unit 5 (24–100 ka)	R	m2
149088	*Urocitellus* sp.	510NW515	Unit 3 (17–20 ka)	L	m2
149092	*Urocitellus* sp.	505NW525	Unit 4 (20–24 ka)	L	m3
149179	*Urocitellus* sp.	515NW520	Unit 3 (17–20 ka)	L	M3
149180	*Urocitellus* sp.	495NW515	mixed Unit 1 & 2	L	M3
149181	*Urocitellus* sp.	505NW515	mixed Unit 1 & 2	L	M3
149182	*Urocitellus* sp.	510NW515B	Unit 3 (17–20 ka)	L	M3
149183	*Urocitellus* sp.	505NW520	Unit 3 (17–20 ka)	R	M3
149184	*Urocitellus* sp.	495NW515	mixed Unit 1 & 2	R	M3
149185	*Urocitellus* sp.	510NW515B	Unit 3 (17–20 ka)	L	M3
149186	*Urocitellus* sp.	495NW515	Unit 3 (17–20 ka)	L	M3
149187	*Urocitellus* sp.	515NW520	Unit 3 (17–20 ka)	L	M3
149188	*Urocitellus* sp.	500NW520	Unit 3 (17–20 ka)	L	M3
149189	*Urocitellus* sp.	500NW520	Unit 2 (12–14 ka)	R	M3
149190	*Urocitellus* sp.	495NW515	Unit 3 (17–20 ka)	R	M3
149191	*Urocitellus* sp.	495NW520	Unit 2 (12–14 ka)	R	M3
149192	*Urocitellus* sp.	520NW525	Unit 1 (10–0 ka)	R	M3
149193	*Urocitellus* sp.	505NW520	Unit 3 (17–20 ka)	R	M3
149194	*Urocitellus* sp.	505NW525	Unit 4 (20–24 ka)	L	M3
149195	*Urocitellus* sp.	495NW515	Unit 3 (17–20 ka)	L	M3
149196	*Urocitellus* sp.	495NW515	Unit 3 (17–20 ka)	R	M3
149252	*Urocitellus* sp.	505NW515	Unit 3 (17–20 ka)	R	P4
149253	*Urocitellus* sp.	500NW515	Unit 3 (17–20 ka)	L	P4
149254	*Urocitellus* sp.	505NW520	Unit 3 (17–20 ka)	R	P4
149255	*Urocitellus* sp.	505NW525	Unit 4 (20–24 ka)	L	P4
149256	*Urocitellus* sp.	495NW520	Unit 3 (17–20 ka)	R	P4
149257	*Urocitellus* sp.	505NW515	Unit 3 (17–20 ka)	R	P4

149258	*Urocitellus* sp.	505NW515	Unit 3 (17–20 ka)	L	P4
149259	*Urocitellus* sp.	505NW525	Unit 4 (20–24 ka)	R	P4
149260	*Urocitellus* sp.	505NW520	Unit 3 (17–20 ka)	R	P4
149261	*Urocitellus* sp.	515NW520	Unit 3 (17–20 ka)	R	P4
149262	*Urocitellus* sp.	505NW520	Unit 3 (17–20 ka)	L	P4
149263	*Urocitellus* sp.	495NW515	Unit 3 (17–20 ka)	L	P4
149125	*Urocitellus* sp.	505NW525	Unit 3 (17–20 ka)	L	m2
149127	*Urocitellus* sp.	515NW520	Unit 3 (17–20 ka)	L	m2
149128	*Urocitellus* sp.	500NW520	Unit 3 (17–20 ka)	L	m2
149129	*Urocitellus* sp.	505NW515	mixed Unit 1 & 2	R	m2
149130	*Urocitellus* sp.	495NW520	Unit 3 (17–20 ka)	R	m2
149132	*Urocitellus* sp.	515NW520	Unit 3 (17–20 ka)	L	m2
149133	*Urocitellus* sp.	505NW525	Unit 3 (17–20 ka)	L	m2
149134	*Urocitellus* sp.	505NW525	Unit 4 (20–24 ka)	L	m2
149135	*Urocitellus* sp.	495NW520	Unit 3 (17–20 ka)	L	m2
149136	*Urocitellus* sp.	505NW515	mixed Unit 1 & 2	L	m2
149137	*Urocitellus* sp.	515NW520	Unit 3 (17–20 ka)	R	m2
149139	*Urocitellus* sp.	505NW515	Unit 3 (17–20 ka)	R	m2
149140	*Urocitellus* sp.	505NW535	Unit 3 (17–20 ka)	L	m2
149141	*Urocitellus* sp.	505NW525	Unit 3 (17–20 ka)	L	m2
149142	*Urocitellus* sp.	495NW515	Unit 3 (17–20 ka)	L	m2
149143	*Urocitellus* sp.	505NW535	Unit 3 (17–20 ka)	R	m1
149146	*Urocitellus* sp.	495NW520	Unit 3 (17–20 ka)	L	m1
149151	*Urocitellus* sp.	500NW520	Unit 1 (10–0 ka)	R	m1
149153	*Urocitellus* sp.	500NW520	Unit 3 (17–20 ka)	R	m1
149155	*Urocitellus* sp.	515NW520	Unit 3 (17–20 ka)	R	m1
149111	*Urocitellus* sp.	500NW515	Unit 3 (17–20 ka)	L	m2
149112	*Urocitellus* sp.	500NW515	Unit 3 (17–20 ka)	R	m2
149114	*Urocitellus* sp.	505NW530	Unit 3 (17–20 ka)	L	m2
149116	*Urocitellus* sp.	515NW520	Unit 3 (17–20 ka)	R	m2
149117	*Urocitellus* sp.	500NW520	Unit 3 (17–20 ka)	L	m2
149119	*Urocitellus* sp.	515NW520	Unit 3 (17–20 ka)	R	m2
149121	*Urocitellus* sp.	505NW525	Unit 4 (20–24 ka)	R	m2
149123	*Urocitellus* sp.	505NW525	Unit 4 (20–24 ka)	L	m2
149124	*Urocitellus* sp.	495NW515	Unit 3 (17–20 ka)	L	m2
149158	*Urocitellus* "big-eared" sp.	500NW515	Unit 3 (17–20 ka)	L	p4
149159	*Urocitellus* "big-eared" sp.	495NW515	Unit 3 (17–20 ka)	L	p4
149160	*Urocitellus* "big-eared" sp.	495NW515	mixed Unit 1 & 2	L	p4
149161	*Urocitellus* "big-eared" sp.	495NW515	Unit 3 (17–20 ka)	R	p4
149162	*Urocitellus* "big-eared" sp.	505NW525	Unit 4 (20–24 ka)	R	p4
149163	*Urocitellus* "big-eared" sp.	495NW515	Unit 3 (17–20 ka)	L	p4
149164	*Urocitellus* "big-eared" sp.	505NW520	Unit 3 (17–20 ka)	L	p4
149165	*Urocitellus* "big-eared" sp.	500NW515	Unit 3 (17–20 ka)	R	p4
149166	*Urocitellus* "big-eared" sp.	505NW525	Unit 3 (17–20 ka)	R	p4
149167	*Urocitellus* "big-eared" sp.	500NW520	Unit 1 (10–0 ka)	R	p4
149168	*Urocitellus* "big-eared" sp.	500NW535	Unit 3 (17–20 ka)	L	p4
149169	*Urocitellus* "big-eared" sp.	500NW535	Unit 3 (17–20 ka)	L	p4
149170	*Urocitellus* "big-eared" sp.	505NW535	possibly Unit 5	R	p4
149171	*Urocitellus* "big-eared" sp.	505NW535	possibly Unit 5	L	p4
149172	*Urocitellus* "big-eared" sp.	505NW525	Unit 4 (20–24 ka)	L	p4

149173	*Urocitellus* "big-eared" sp.	500NW520	Unit 3 (17–20 ka)	L	p4
149174	*Urocitellus* "big-eared" sp.	500NW520	Unit 3 (17–20 ka)	L	p4
149175	*Urocitellus* "big-eared" sp.	495NW520	Unit 3 (17–20 ka)	R	p4
149176	*Urocitellus* "big-eared" sp.	495NW520	Unit 1 (10–0 ka)	L	p4
149177	*Urocitellus* "big-eared" sp.	500NW520	Unit 3 (17–20 ka)	R	p4
149178	*Urocitellus* "big-eared" sp.	515NW520	Unit 3 (17–20 ka)	R	p4
149245	*Urocitellus* "big-eared" sp.	495NW520	Unit 3 (17–20 ka)	R	M3
149292	*Urocitellus* "big-eared" sp.	520NW525	Unit 3 (17–20 ka)	L	p4
149054	*Urocitellus* "big-eared" sp.	510NW515	Unit 5 (24–100 ka)	R	p4
149084	*Urocitellus* "big-eared" sp.	510NW515B	Unit 3 (17–20 ka)	R	p4
149085	*Urocitellus* "big-eared" sp.	510NW515	Unit 5 (24–100 ka)	L	M3
149077	*Urocitellus* "big-eared" sp.	495NW515	Unit 3 (17–20 ka)	R	p4
149074	*Urocitellus* "big-eared" sp.	505NW525	Unit 4 (20–24 ka)	L	dent.
149061	*Urocitellus* "big-eared" sp.	520NW525	Unit 2 (12–14 ka)	R	M3
149273	*Urocitellus* "big-eared" sp.	500NW515	Unit 3 (17–20 ka)	L	max.
149079	*Urocitellus richardsonii/elegans*	510NW515	Unit 3 (17–20 ka)	R	m3
149091	*Urocitellus richardsonii/elegans*	505NW525	Unit 3 (17–20 ka)	L	m3
149093	*Urocitellus richardsonii/elegans*	500NW520	Unit 3 (17–20 ka)	L	m3
149094	*Urocitellus richardsonii/elegans*	495NW515	Unit 3 (17–20 ka)	L	m3
149095	*Urocitellus richardsonii/elegans*	495NW515	Unit 3 (17–20 ka)	L	m3
149096	*Urocitellus richardsonii/elegans*	505NW525	Unit 3 (17–20 ka)	L	m3
149097	*Urocitellus richardsonii/elegans*	495NW520	Unit 3 (17–20 ka)	L	m3
149098	*Urocitellus richardsonii/elegans*	495NW515	Unit 3 (17–20 ka)	L	m3
149099	*Urocitellus richardsonii/elegans*	500NW515	Unit 3 (17–20 ka)	L	m3
149100	*Urocitellus richardsonii/elegans*	500NW520	Unit 1 (10–0 ka)	R	m3
149101	*Urocitellus richardsonii/elegans*	505NW515	Unit 3 (17–20 ka)	R	m3
149102	*Urocitellus richardsonii/elegans*	505NW525	Unit 4 (20–24 ka)	R	m3
149103	*Urocitellus richardsonii/elegans*	505NW525	Unit 4 (20–24 ka)	R	m3
149104	*Urocitellus richardsonii/elegans*	505NW535	Unit 3 (17–20 ka)	R	m3
149105	*Urocitellus richardsonii/elegans*	500NW515	Unit 3 (17–20 ka)	R	m3
149106	*Urocitellus richardsonii/elegans*	505NW520	Unit 3 (17–20 ka)	R	m3
149107	*Urocitellus richardsonii/elegans*	505NW535	Unit 3 (17–20 ka)	R	m3
149108	*Urocitellus richardsonii/elegans*	505NW515	Unit 3 (17–20 ka)	R	m3
149109	*Urocitellus richardsonii/elegans*	505NW520	Unit 3 (17–20 ka)	R	m3
149110	*Urocitellus richardsonii/elegans*	495NW520	Unit 3 (17–20 ka)	R	m3
97670	*Urocitellus richardsonii/elegans*	505NW515	Unit 3 (17–20 ka)	L	m3
145139	*Urocitellus richardsonii/elegans*	505NW515	Unit 3 (17–20 ka)	L	m3
145140	*Urocitellus richardsonii/elegans*	520NW495	Unit 1 (10–0 ka)	L	m3
149051	*Urocitellus richardsonii/elegans*	510NW515A	possibly Unit 4	R	jaw
149052	*Urocitellus richardsonii/elegans*	510NW515B	Unit 3 (17–20 ka)	R	m3
97650	*Urocitellus richardsonii/elegans*	505NW515	Unit 3 (17–20 ka)	R	m2-3
149055	*Urocitellus richardsonii/elegans*	510NW515A	Unit 5 (24–100 ka)	L	dent.
149274	*Urocitellus richardsonii/elegans*	495NW515	Unit 3 (17–20 ka)	L	dent.
52259	*Marmota* sp.	500NW515	Unit 3 (17–20 ka)	L	i1
148205	*Marmota* sp.	Trench	Unit 3 (17–20 ka)	L	i1
148206	*Marmota* sp.	Trench	Unit 3 (17–20 ka)	R	i1
148208	*Marmota* sp.	500NW515	Unit 3 (17–20 ka)	R	i1
78126	*Marmota* sp.	485NW535	Unit 3 (17–20 ka)	R	i1
28042	*Marmota* sp.	485NW535	Unit 1 (10–0 ka)	R	I1
124791	*Marmota* sp.	505NW510	mixed Unit 1 & 2	R	I1

148139	*Marmota* sp.	515NW485	Unit 2 (12–14 ka)	R	I1	
148143	*Marmota* sp.	525NW485	Unit 2 (12–14 ka)	R	I1	
148144	*Marmota* sp.		Unit 3 (17–20 ka)	R	I1	
148151	*Marmota* sp.	500NW515	Unit 3 (17–20 ka)	R	I1	
148207	*Marmota* sp.	Trench	Unit 3 (17–20 ka)	R	I1	
148213	*Marmota* sp.	510NW500	possibly Unit 2	R	I1	
35688	*Marmota* sp.	495NW525	Unit 3 (17–20 ka)	L	jaw	i1 p4-m3
148149	*Marmota* sp.	520NW505	Unit 2 (12–14 ka)	L	jaw	i1
148148	*Marmota* sp.	525NW485	Unit 1 (10–0 ka)	L	jaw	i1 p4
145138	*Marmota* sp.	485NW535	Unit 3 (17–20 ka)	L	jaw	i1 p4-m1
47392	*Marmota* sp.	505NW530	Unit 3 (17–20 ka)	L	jaw	i1 p4-m3
64669	*Marmota* sp.	520NW505	Unit 2 (12–14 ka)	L	jaw	p4-m2
64829	*Marmota* sp.	end of trench	Unit 3 (17–20 ka)	L & R	jaws	complete
148140	*Marmota* sp.	525NW485	Unit 1 (10–0 ka)	R	jaw	edent.
48496	*Marmota* sp.	495NW520	Unit 3 (17–20 ka)	R	jaw	i1
126819	*Marmota* sp.	Trench	Unit 3 (17–20 ka)	R	jaw	i1
67206	*Marmota* sp.	505NW485	Unit 2 (12–14 ka)	R	jaw	i1 p4-m2
27991	*Marmota* sp.	crawl way	possibly Unit 1	R	jaw	i1, m3
44245	*Marmota* sp.	520NW490	Unit 1 (10–0 ka)	R	jaw	p4-m1
147883	*Marmota* sp.		Unit 3 (17–20 ka)	R	p4	
148142	*Marmota* sp.	510NW505	possibly Unit 6	R	m	
64735	*Marmota* sp.	510NW500	possibly Unit 3	L	m1	
148141	*Marmota* sp.	500NW505	Unit 6 (>100 ka)	L	m1	
148150	*Marmota* sp.	510NW500	possibly Unit 2	L	m1	
64775	*Marmota* sp.	520NW505	Unit 2 (12–14 ka)	L	m3	
148146	*Marmota* sp.	505NW505	possibly Unit 6	R	m3	
148145	*Marmota* sp.	510NW505	Unit 6 (>100 ka)	R	P4	
148147	*Marmota* sp.	520NW505	Unit 2 (12–14 ka)	L	M1 or M2	
64649	*Marmota* sp.	520NW505	Unit 2 (12–14 ka)	R	M2	
64650	*Marmota* sp.	520NW505	Unit 2 (12–14 ka)	L	max.	P4
64733	*Marmota* sp.	slump	?	R	max.	P4
98113	*Marmota* sp.	520NW505	Unit 2 (12–14 ka)	L	max.	P4
62399	*Marmota* sp.	Gen. coll. trench	?	L	max.	P3-M3
124063	*Marmota* sp.	500NW510	mixed Unit 1 & 2	L	premax.	I1
126817	*Marmota* sp.	517NW515	?	L	premax.	I1
148226	*Marmota* sp.	505NW485	Unit 2 (12–14 ka)	L	premax.	I1
27526	*Marmota* sp.	580NW465	?		skull occ./R aud. bulla	
36352	*Marmota* sp.	495NW530	Unit 3 (17–20 ka)	R	humerus	
38538	*Marmota* sp.	495NW530	Unit 3 (17–20 ka)	R	tibia	
148270	*Marmota* sp.	505NW485	Unit 2 (12–14 ka)	R	I1	
148274	*Marmota* sp.	495NW510	mixed Unit 1 & 2	L	jaw	p4, m3
148300	*Marmota* sp.	480NW515	possibly Unit 1	R	jaw	i1
148348	*Marmota* sp.	510NW485	Unit 2 (12–14 ka)	L	jaw	p4
148910	*Marmota* sp.	520NW510	Unit 2 (12–14 ka)	R	M1/2	
148911	*Marmota* sp.	495NW515	Unit 3 (17–20 ka)	R	P3	
148912	*Marmota* sp.	495NW515	Unit 3 (17–20 ka)	R	M3	
148913	*Marmota* sp.	495NW515	Unit 3 (17–20 ka)	L	M1/2	
148914	*Marmota* sp.	495NW515	Unit 3 (17–20 ka)	L	M3	
148915	*Marmota* sp.	495NW515	Unit 3 (17–20 ka)	R	P4	
148916	*Marmota* sp.	495NW515	Unit 3 (17–20 ka)	L	P4	

148917	*Marmota* sp.	495NW515	Unit 3 (17–20 ka)	R	M1/2	
148918	*Marmota* sp.	495NW515	Unit 3 (17–20 ka)	L	M1/2	
148919	*Marmota* sp.	495NW515	Unit 3 (17–20 ka)	R	M1/2	
148920	*Marmota* sp.	510NW515B	Unit 4 (20–24 ka)	L	M1/2	
148921	*Marmota* sp.	500NW515	Unit 3 (17–20 ka)	L	P4	
148922	*Marmota* sp.	505NW515	Unit 3 (17–20 ka)	L	P4	
148923	*Marmota* sp.	500NW515	Unit 3 (17–20 ka)	R	M1/2	
148924	*Marmota* sp.	505NW515	Unit 3 (17–20 ka)	R	P4	
148925	*Marmota* sp.	505NW525	Unit 3 (17–20 ka)	L	M1/2	
148926	*Marmota* sp.	520NW490	Unit 3 (17–20 ka)	L	M1/2	
148927	*Marmota* sp.	520NW490	Unit 2 (12–14 ka)	L	m3	
148928	*Marmota* sp.	505NW520	Unit 3 (17–20 ka)	L	p4	
148929	*Marmota* sp.	505NW525	Unit 3 (17–20 ka)	L	M3	
148930	*Marmota* sp.	500NW515	Unit 3 (17–20 ka)	L	M3	
148931	*Marmota* sp.	500NW515	Unit 3 (17–20 ka)	R	P4	
148932	*Marmota* sp.	520NW490	Unit 2 (12–14 ka)	L	P4	
148933	*Marmota* sp.	505NW515	Unit 3 (17–20 ka)	L	M3	
148934	*Marmota* sp.	500NW520	Unit 3 (17–20 ka)	L	M1/2	
148935	*Marmota* sp.	515NW520	Unit 3 (17–20 ka)	R	P4	
148936	*Marmota* sp.	500NW515	Unit 3 (17–20 ka)	L	m3	
149080	*Marmota* sp.	510NW515B	Unit 5 (24–100 ka)	L	P3	
42740	*Marmota flaviventris*	505NW535	Unit 3 (17–20 ka)	n/a	ass. skeleton	
27568	*Tamias (Neotamias)*	580NW465	possibly Unit 3	L	dent.	p4-m1
62782	*Tamias (Neotamias)*	520NW490	Unit 2 (12–14 ka)	R	dent.	i1 p4-m2
64612	*Tamias (Neotamias)*	520NW505	Unit 2 (12–14 ka)	L	dent.	i1 p4-m3
64614	*Tamias (Neotamias)*	520NW505	Unit 2 (12–14 ka)	R	dent.	i1 p4-m2
64615	*Tamias (Neotamias)*	520NW505	Unit 2 (12–14 ka)	R	dent.	m1-m2
64616	*Tamias (Neotamias)*	520NW505	Unit 2 (12–14 ka)	R	dent.	m1
64617	*Tamias (Neotamias)*	520NW505	Unit 2 (12–14 ka)	R	dent.	m1
64660	*Tamias (Neotamias)*	480NW515	possibly Unit 1	R	dent.	p4 m1
64663	*Tamias (Neotamias)*	500NW450	possibly Unit 2	R	dent.	m1-m3
64677	*Tamias (Neotamias)*	520NW505	Unit 2 (12–14 ka)	R	dent.	i1 p4-m3
64679	*Tamias (Neotamias)*	520NW505	Unit 2 (12–14 ka)	R	dent.	i1 p4-m3
64684	*Tamias (Neotamias)*	525NW485	Unit 1 (10–0 ka)	L	dent.	p4-m3
64693	*Tamias (Neotamias)*	480NW515	Unit 2 (12–14 ka)	L	dent.	i1 p4-m3
64712	*Tamias (Neotamias)*	slump	?	R	dent.	p4 m1
64720	*Tamias (Neotamias)*	n/a	Unit 3 (17–20 ka)	L	dent.	i1 m1
64749	*Tamias (Neotamias)*	500NW450	Unit 1 (10–0 ka)	L	dent.	p4 m1
64783	*Tamias (Neotamias)*	500NW515	Unit 5 (24–100 ka)	L	dent.	m1-m3
64794	*Tamias (Neotamias)*	480NW515	Unit 1 (10–0 ka)	L	dent.	i1, p4-m2
64795	*Tamias (Neotamias)*	480NW515	Unit 1 (10–0 ka)	R	dent.	dp4-m1
64802	*Tamias (Neotamias)*	no data	?	R	dent.	p4, m1
64809	*Tamias (Neotamias)*	515NW485	Unit 1 (10–0 ka)	L	dent.	i1 p4-m1
64825	*Tamias (Neotamias)*	515NW485	Unit 2 (12–14 ka)	L	dent.	i1 m1
64826	*Tamias (Neotamias)*	515NW485	Unit 2 (12–14 ka)	R	dent.	i1 p4-m1
67159	*Tamias (Neotamias)*	no data	?	L	dent.	i1 p4-m1
67923	*Tamias (Neotamias)*	505NW485	Unit 1 (10–0 ka)	L	dent.	i1 m1
67933	*Tamias (Neotamias)*	525NW485	Unit 1 (10–0 ka)	L	dent.	i1 p4-m2
67934	*Tamias (Neotamias)*	525NW485	Unit 1 (10–0 ka)	R	dent.	p4-m2

67967	*Tamias (Neotamias)*	525NW485	Unit 2 (12–14 ka)	L	dent.	i1 m1-m2
67988	*Tamias (Neotamias)*	580NW465	possibly Unit 2	L	dent.	p4-m2
97345	*Tamias (Neotamias)*	517NW515	?	R	dent.	p4 m1
97391	*Tamias (Neotamias)*	515NW485	Unit 2 (12–14 ka)	L	dent.	p4-m2
124766	*Tamias (Neotamias)*	505NW510	mixed Unit 1 & 2	R	dent.	p4 m1
127019	*Tamias (Neotamias)*	580NW465	possibly Unit 1		skull	RP4 M1, LM1 M3
127021	*Tamias (Neotamias)*	540NW465	possibly Unit 1	R	dent.	p4 m1
127022	*Tamias (Neotamias)*	500NW450	Unit 1 (10–0 ka)	R	dent.	m1
146975	*Tamias (Neotamias)*	n/a	Unit 6 (>100ka)	L	max.	M1
146979	*Tamias (Neotamias)*	510NW505	possibly Unit 6	L	max.	unerupted P4
146981	*Tamias (Neotamias)*	510NW505	Unit 6 (>100ka)	R	dent.	i1 p4-m2
146982	*Tamias (Neotamias)*	510NW505	possibly Unit 6	R	dent.	i1 p4-m3
146983	*Tamias (Neotamias)*	510NW505	Unit 6 (>100ka)	R	dent.	m1
146984	*Tamias (Neotamias)*	510NW505	possibly Unit 6	L	dent.	i1 p4-m1
146985	*Tamias (Neotamias)*	n/a	Unit 6 (>100ka)	R	dent.	m1-m2
146986	*Tamias (Neotamias)*	505NW505	Unit 6 (>100ka)	R	max.	dP4
146987	*Tamias (Neotamias)*	505NW505	Unit 6 (>100ka)	L	max.	M1
146991	*Tamias (Neotamias)*	505NW505	Unit 6 (>100ka)	L	max.	dP4
146994	*Tamias (Neotamias)*	505NW505	possibly Unit 6	L	dent.	m2
146996	*Tamias (Neotamias)*	505NW505	Unit 6 (>100ka)	L	max.	M1
146997	*Tamias (Neotamias)*	505NW505	Unit 6 (>100ka)	R	dent.	m1-m2
146998	*Tamias (Neotamias)*	505NW505	Unit 6 (>100ka)	R	dent.	p4-m1
146999	*Tamias (Neotamias)*	505NW505	Unit 6 (>100ka)	L	dent.	i1 p4-m1
147000	*Tamias (Neotamias)*	505NW505	Unit 6 (>100ka)	L	dent.	m2
147001	*Tamias (Neotamias)*	505NW505	Unit 6 (>100ka)	R	dent.	m1
147002	*Tamias (Neotamias)*	505NW505	Unit 6 (>100ka)	L	dent.	m1
147004	*Tamias (Neotamias)*	505NW505	Unit 6 (>100ka)	R	max.	P4
147005	*Tamias (Neotamias)*	510NW505	Unit 6 (>100ka)	R	max.	M1
147007	*Tamias (Neotamias)*	510NW505	possibly Unit 6	R	max.	P4-M1
147008	*Tamias (Neotamias)*	500NW505	Unit 6 (>100ka)	L	dent.	i1 p4-m2
147009	*Tamias (Neotamias)*	500NW505	Unit 6 (>100ka)	R	dent.	p4-m1
147012	*Tamias (Neotamias)*	510NW505	possibly Unit 6	R	dent.	i1 m1
147013	*Tamias (Neotamias)*	510NW505	possibly Unit 6	R	max.	P4-M3
147016	*Tamias (Neotamias)*	500NW505	Unit 6 (>100ka)	L	max.	P4 M1 M3
147020	*Tamias (Neotamias)*	510N	Unit 6 (>100ka)	R	dent.	m1
147023	*Tamias (Neotamias)*	505NW505	possibly Unit 6	R	dent.	p4-m2
147024	*Tamias (Neotamias)*	505NW505	possibly Unit 6	L	dent.	m1-m2
147025	*Tamias (Neotamias)*	510NW505	Unit 6 (>100ka)	R	max.	P4
147026	*Tamias (Neotamias)*	n/a	Unit 6 (>100ka)	R	max.	P4-M1
147030	*Tamias (Neotamias)*	510NW505	Unit 6 (>100ka)	R	dent.	m1-m2
147031	*Tamias (Neotamias)*	510NW505	Unit 6 (>100ka)	R	dent.	m1 m2
147032	*Tamias (Neotamias)*	510NW505	Unit 6 (>100ka)	R	dent.	p4 m1
147034	*Tamias (Neotamias)*	510NW505	Unit 6 (>100ka)	L	dent.	i1 p4
147036	*Tamias (Neotamias)*	510NW505	Unit 6 (>100ka)	L	max.	P4
147039	*Tamias (Neotamias)*	510NW505	possibly Unit 6	R	dent.	m1
147040	*Tamias (Neotamias)*	510NW505	possibly Unit 6	R	dent.	i1 m1
147043	*Tamias (Neotamias)*	510NW505	possibly Unit 6	R	dent.	m1

147048	*Tamias (Neotamias)*	510NW505	possibly Unit 6	L	max.	P4
147049	*Tamias (Neotamias)*	510NW505	Unit 6 (>100ka)	R	max.	M1
147053	*Tamias (Neotamias)*	510NW505	Unit 6 (>100ka)	R	dent.	p4
147055	*Tamias (Neotamias)*	510NW505	Unit 6 (>100ka)	L	dent.	p4 m1
147059	*Tamias (Neotamias)*	510NW505	Unit 6 (>100ka)	R	dent.	i1 m1 m2
147066	*Tamias (Neotamias)*	525NW485	Unit 1 (10–0 ka)	R	max.	P4 M1
147067	*Tamias (Neotamias)*	485-490NW515	Unit 5 (24–100 ka)	R	dent.	m1
147073	*Tamias (Neotamias)*	510NW500	possibly Unit 2	L	dent.	m1
147074	*Tamias (Neotamias)*	520NW505	Unit 1 (10–0 ka)	R	dent.	i1 m1-2
147075	*Tamias (Neotamias)*	505NW505	possibly Unit 6	R	max.	M1
147076	*Tamias (Neotamias)*	520NW505	Unit 2 (12–14 ka)	L	dent.	m1
147077	*Tamias (Neotamias)*	515NW465	Unit 3 (17–20 ka)	L	dent.	i1 p4-m1
147078	*Tamias (Neotamias)*	515NW485	Unit 3 (17–20 ka)	L	dent.	m1
147085	*Tamias (Neotamias)*	495-500NW515	possibly Unit 6	R	dent.	p4-m2
147086	*Tamias (Neotamias)*	500NW505	possibly Unit 6	L	dent.	m1
147087	*Tamias (Neotamias)*	510NW505	Unit 6 (>100ka)	L	max.	M1
147088	*Tamias (Neotamias)*	510NW505	Unit 6 (>100ka)	R	max.	M1-3
147089	*Tamias (Neotamias)*	505n	Unit 6 (>100ka)	R	dent.	m2
147090	*Tamias (Neotamias)*	510NW505	Unit 6 (>100ka)	R	max.	dP4
147092	*Tamias (Neotamias)*	505NW505	possibly Unit 6	L	dent.	m1
147093	*Tamias (Neotamias)*	505NW505	possibly Unit 6	R	max.	P3-M3
147095	*Tamias (Neotamias)*	510NW505	Unit 6 (>100ka)	L	max.	M2-3
147098	*Tamias (Neotamias)*	495-500NW515	Unit 6 (>100ka)	L	max.	dP4
147099	*Tamias (Neotamias)*	505NW505	possibly Unit 6	L & R	max.s	RP4 M3
147101	*Tamias (Neotamias)*	495-500NW515	possibly Unit 6	L	max.	P4-M1
147103	*Tamias (Neotamias)*	510NW505	Unit 6 (>100ka)	R	dent.	p4-m2
147104	*Tamias (Neotamias)*	510NW505	Unit 6 (>100ka)	L	dent.	i1 p4-m3
147105	*Tamias (Neotamias)*	505NW505	possibly Unit 6	R	dent.	i1 p4-m1
147976	*Tamias (Neotamias)*	520NW505	Unit 2 (12–14 ka)	R	dent.	m1
147977	*Tamias (Neotamias)*	500NW450	Unit 1 (10–0 ka)	L	dent.	m2
147981	*Tamias (Neotamias)*	505NW515	Unit 3 (17–20 ka)	L	dent.	i1 p4-m2
147995	*Tamias (Neotamias)*	520NW495	Unit 1 (10–0 ka)	R	max.	M1
148055	*Tamias (Neotamias)*	520NW495	Unit 1 (10–0 ka)	R	dent.	m1-3
148278	*Tamias (Neotamias)*	495NW510	mixed Unit 1 & 2	R	dent.	m1-2
148279	*Tamias (Neotamias)*	495NW510	mixed Unit 1 & 2	R	dent.	m1
148351	*Tamias (Neotamias)*	510NW485	Unit 2 (12–14 ka)	R	dent.	m1
148790	*Tamias (Neotamias)*	495NW515	Unit 4 (20–24 ka)	L	max.	M2
148793	*Tamias (Neotamias)*	500NW520	Unit 2 (12–14 ka)	L	dent.	m1-m3
148795	*Tamias (Neotamias)*	495NW515	Unit 3 (17–20 ka)	L	max.	P3-M2
148796	*Tamias (Neotamias)*	495NW515	Unit 4 (20–24 ka)	R	max.	M1
148800	*Tamias (Neotamias)*	520NW510	Unit 2 (12–14 ka)	R	dent.	i1 m1-3
148801	*Tamias (Neotamias)*	520NW490	Unit 2 (12–14 ka)	R	dent.	i1 m1
148803	*Tamias (Neotamias)*	495NW515	Unit 5 (24–100 ka)	R	dent.	m1-m3
148805	*Tamias (Neotamias)*	510NW515B	Unit 5 (24–100 ka)	L	dent.	m1
148806	*Tamias (Neotamias)*	500NW520	Unit 1 (10–0 ka)	L	max.	M1
148807	*Tamias (Neotamias)*	495NW515	Unit 3 (17–20 ka)	R	max.	P4 M1-M3
148808	*Tamias (Neotamias)*	520NW490	Unit 2 (12–14 ka)	R	dent.	m1
148811	*Tamias (Neotamias)*	505NW515	mixed Unit 1 & 2	R	dent.	m1
148813	*Tamias (Neotamias)*	520NW510	Unit 2 (12–14 ka)	L	dent.	p4 m1

149290	*Tamias (Neotamias)*	505NW505	possibly Unit 6	R	dent.	p4-m2
149300	*Tamias (Neotamias)*	520NW490	Unit 2 (12–14 ka)	L	jaw	p4
149331	*Tamias (Neotamias)*	510NW505	Unit 6 (>100ka)	R	jaw	p4
149334	*Tamias (Neotamias)*	500NW505	possibly Unit 6	R	jaw	m1-m2
149338	*Tamias (Neotamias)*	505NW505	Unit 6 (>100ka)	L	jaw	m1
149339	*Tamias (Neotamias)*	?	Unit 6 (>100ka)	R	max.	P3-M1
149362	*Tamias (Neotamias)*	510NW505	possibly Unit 6	L	jaw	i1 m1-2
149363	*Tamias (Neotamias)*	510NW505	possibly Unit 6	R	jaw	p4-m2
64618	*Tamias (Neotamias)* small sp.	520NW505	Unit 2 (12–14 ka)	L	dent.	i1 p4-m2
64620	*Tamias (Neotamias)* small sp.	520NW505	Unit 2 (12–14 ka)		skull	L M1 M3 R P4M1M3
64705	*Tamias (Neotamias)* small sp.	slump	?	L	dent.	i1 p4 m1
97603	*Tamias (Neotamias)* small sp.	515NW485	possibly Unit 2	R	max.	P3-M1
146971	*Tamias (Neotamias)* small sp.	n/a	Unit 6 (>100ka)	L	dent.	p4-m3
146972	*Tamias (Neotamias)* small sp.	510NW505	Unit 6 (>100ka)	R	dent.	p4-m2
146974	*Tamias (Neotamias)* small sp.	n/a	Unit 6 (>100ka)	R	max.	dP4-M1
146980	*Tamias (Neotamias)* small sp.	510NW505	possibly Unit 6	L	max.	M1
146988	*Tamias (Neotamias)* small sp.	505NW505	Unit 6 (>100ka)	R	max.	P3-M1
147003	*Tamias (Neotamias)* small sp.	505NW505	Unit 6 (>100ka)	R	max.	dP4
147010	*Tamias (Neotamias)* small sp.	500NW505	Unit 6 (>100ka)	R	max.	P3-M1
147014	*Tamias (Neotamias)* small sp.	510NW505	possibly Unit 6	L	max.	P4 M2
147015	*Tamias (Neotamias)* small sp.	510NW505	possibly Unit 6	R	max.	P4 M1
147022	*Tamias (Neotamias)* small sp.	510NW500	Unit 1 (10–0 ka)	L	dent.	i1 p4-m2
147027	*Tamias (Neotamias)* small sp.	510NW505	Unit 6 (>100ka)	L	max.	P4-M3
147035	*Tamias (Neotamias)* small sp.	510NW505	Unit 6 (>100ka)	L	dent.	p4-m2
147037	*Tamias (Neotamias)* small sp.	510NW505	Unit 6 (>100ka)	L	max.	M1 M3
147038	*Tamias (Neotamias)* small sp.	510NW505	possibly Unit 6	R	dent.	p4-m1
147041	*Tamias (Neotamias)* small sp.	510NW505	possibly Unit 6	R	dent.	p4
147042	*Tamias (Neotamias)* small sp.	510NW505	possibly Unit 6	R	dent.	i1 p4-m3
147051	*Tamias (Neotamias)* small sp.	505NW505	Unit 6 (>100ka)	L	dent.	i1 p4
147054	*Tamias (Neotamias)* small sp.	510NW505	Unit 6 (>100ka)	L	dent.	p4 m1
147056	*Tamias (Neotamias)* small sp.	505NW505	possibly Unit 6	R	max.	P4-M1
147060	*Tamias (Neotamias)* small sp.	n/a	Unit 6 (>100ka)	R	max.	P4 M1
147065	*Tamias (Neotamias)* small sp.	n/a	Unit 6 (>100ka)	L	dent.	i1 p4-m2
147094	*Tamias (Neotamias)* small sp.	505NW505	possibly Unit 6	L	dent.	p4
147096	*Tamias (Neotamias)* small sp.	505NW505	possibly Unit 6	L	dent.	i1 p4-m3
147102	*Tamias (Neotamias)* small sp.	510N	Unit 6 (>100ka)	L	max.	P4-M2
147106	*Tamias (Neotamias)* small sp.	510NW505	Unit 6 (>100ka)	R	max.	P4-M3
147107	*Tamias (Neotamias)* small sp.	510NW505	Unit 6 (>100ka)	L	dent.	p4 m1
147983	*Tamias (Neotamias)* small sp.	520NW505	Unit 2 (12–14 ka)	R	dent.	p4
148153	*Tamias (Neotamias)* small sp.	505N	Unit 6 (>100ka)	R	max.	P4
148204	*Tamias (Neotamias)* small sp.	500NW450	Unit 1 (10–0 ka)	L	max.	P4 M1
148788	*Tamias (Neotamias)* small sp.	580NW465	possibly Unit 2	R	max.	P4
148791	*Tamias (Neotamias)* small sp.	510NW515B	Unit 4 (210–00 ka)	R	dent.	m2
148792	*Tamias (Neotamias)* small sp.	520NW510	Unit 1 (10–0 ka)	L	dent.	p4
148794	*Tamias (Neotamias)* small sp.	580NW465	possibly Unit 2	L & R	max.	L P4 M1 R P4 M1
148797	*Tamias (Neotamias)* small sp.	495NW520	Unit 2 (12–14 ka)	R	dent.	M3
						p4-m2

148799	*Tamias (Neotamias)* small sp.	495NW515	mixed Unit 1 & 2	L	max.	P4 M1 M3
148804	*Tamias (Neotamias)* small sp.	580NW465	possibly Unit 2	R	max.	P4
148814	*Tamias (Neotamias)* small sp.	505NW535	Unit 5 (24–100 ka)	L & R	dent.	LR p4-m3
27569	*Tamias (Neotamias)* medium sp.	580NW465	possibly Unit 3	L	dent.	m1
32340	*Tamias (Neotamias)* medium sp.	500NW530	possibly Unit 2	L	dent.	i1 m1
64668	*Tamias (Neotamias)* medium sp.	517NW515	Unit 3 (17–20 ka)	R	dent.	i1 m1-m3
64736	*Tamias (Neotamias)* medium sp.	510NW500	Unit 3 (17–20 ka)	L	dent.	m1-m2
64742	*Tamias (Neotamias)* medium sp.	500NW450	Unit 1 (10–0 ka)	R	dent.	p4 m1
64776	*Tamias (Neotamias)* medium sp.	520NW505	Unit 2 (12–14 ka)	L	dent.	i1 m1 m2
64803	*Tamias (Neotamias)* medium sp.	no data	?	L	dent.	i1 p4-m2
67193	*Tamias (Neotamias)* medium sp.	520NW490	Unit 1 (10–0 ka)	R	dent.	p4-m2
67935	*Tamias (Neotamias)* medium sp.	525NW485	Unit 1 (10–0 ka)	L	dent.	i1 m1
97462	*Tamias (Neotamias)* medium sp.	517NW515	?	L	dent.	unerupte p4 m1
98098	*Tamias (Neotamias)* medium sp.	515NW485	Unit 1 (10–0 ka)	R	dent.	m1
124763	*Tamias (Neotamias)* medium sp.	505NW510	mixed Unit 1 & 2	L	dent.	i1 m1
127020	*Tamias (Neotamias)* medium sp.	500NW450	Unit 1 (10–0 ka)	L & R	max.	RM1
146969	*Tamias (Neotamias)* medium sp.	n/a	Unit 6 (>100ka)	L	dent.	m1
146970	*Tamias (Neotamias)* medium sp.	510NW505	Unit 6 (>100ka)	R	max.	M1
146976	*Tamias (Neotamias)* medium sp.	510NW505	Unit 6 (>100ka)	R	dent.	m1
146990	*Tamias (Neotamias)* medium sp.	510NW505	Unit 6 (>100ka)	L	max.	M1
146992	*Tamias (Neotamias)* medium sp.	505NW505	Unit 6 (>100ka)	R	max.	M1
146993	*Tamias (Neotamias)* medium sp.	505NW505	possibly Unit 6	L	max.	M1
146995	*Tamias (Neotamias)* medium sp.	505NW505	possibly Unit 6	R	dent.	m1-m2
147006	*Tamias (Neotamias)* medium sp.	505NW505	Unit 6 (>100ka)	L	max.	M1-M2
147028	*Tamias (Neotamias)* medium sp.	510NW505	Unit 6 (>100ka)	R	dent.	i1 m1
147050	*Tamias (Neotamias)* medium sp.	510NW505	Unit 6 (>100ka)	L	max.	M1-M2
147052	*Tamias (Neotamias)* medium sp.	510NW505	Unit 6 (>100ka)	R	max.	M1
147057	*Tamias (Neotamias)* medium sp.	n/a	Unit 6 (>100ka)	L	dent.	i1 p4-m2
147070	*Tamias (Neotamias)* medium sp.	520NW490	Unit 2 (12–14 ka)	L	dent.	m1
147091	*Tamias (Neotamias)* medium sp.	505NW505	possibly Unit 6	L	dent.	p4 m1
147100	*Tamias (Neotamias)* medium sp.	510N	Unit 6 (>100ka)	L	dent.	m1
147980	*Tamias (Neotamias)* medium sp.	520NW505	Unit 1 (10–0 ka)	L	max.	M1-M2
148350	*Tamias (Neotamias)* medium sp.	510NW485	Unit 2 (12–14 ka)	R	dent.	m1
148787	*Tamias (Neotamias)* medium sp.	500NW515	Unit 6 (>100ka)	R	dent.	m1 m2
148789	*Tamias (Neotamias)* medium sp.	520NW490	Unit 2 (12–14 ka)	L	max.	M1
148802	*Tamias (Neotamias)* medium sp.	495NW515	Unit 3 (17–20 ka)	L	max.	M1
148812	*Tamias (Neotamias)* medium sp.	520NW490	Unit 2 (12–14 ka)	R	dent.	m1
42738	*Tamias minimus*	505NW535	Unit 5 (24–100 ka)	L & R	dent.	LR i1, p4-m2
64710	*Tamias minimus*	slump	?	L	dent.	i1 p4 m1
98013	*Tamias minimus*	520NW500	Unit 2 (12–14 ka)	R	dent.	i1 p4-m2
146989	*Tamias minimus*	505NW505	Unit 6 (>100ka)	L	max.	P3-M2
147011	*Tamias minimus*	500NW505	Unit 6 (>100ka)	L	max.	P3-M3
147018	*Tamias minimus*	505NW505	Unit 6 (>100ka)	L	dent.	i1 p4-m2
147033	*Tamias minimus*	510NW505	Unit 6 (>100ka)	L	dent.	p4-m2
147058	*Tamias minimus*	510NW505	Unit 6 (>100ka)	R	dent.	i1 p4-m2

147061	*Tamias minimus*	n/a	Unit 6 (>100ka)	L	dent.	i1 unerupted p4 m1
147063	*Tamias minimus*	510NW505	Unit 6 (>100ka)	R	dent.	i1 p4 m1
147097	*Tamias minimus*	510NW505	Unit 6 (>100ka)	R	max.	P3-M1 M3
147982	*Tamias minimus*	520NW505	Unit 2 (12–14 ka)	R	dent.	i1, p4-m2
148809	*Tamias minimus*	505NW515	mixed Unit 1 & 2	R	dent.	p4, m1
148810	*Tamias minimus*	580NW465	possibly Unit 2	L	dent.	i1, p4-m2
149358	*Tamias minimus*	510NW505	possibly Unit 6	R	jaw	i1 p4-m2
27629	*Tamias (Neotamias)* large sp.	515NW540	Unit 1 (10–0 ka)	L	dent.	i1 m1-2
64613	*Tamias (Neotamias)* large sp.	520NW505	Unit 2 (12–14 ka)	R	dent.	m1-m2
64619	*Tamias (Neotamias)* large sp.	520NW505	Unit 2 (12–14 ka)	n/a	palate	LR M1
146973	*Tamias (Neotamias)* large sp.	510NW505	possibly Unit 6	R	dent.	m1-m2
147021	*Tamias (Neotamias)* large sp.	510NW505	Unit 6 (>100ka)	R	dent.	m1-m2
147029	*Tamias (Neotamias)* large sp.	510NW505	Unit 6 (>100ka)	R	dent.	i1 m2
147062	*Tamias (Neotamias)* large sp.	n/a	Unit 6 (>100ka)	R	dent.	m1
147064	*Tamias (Neotamias)* large sp.	525NW485	Unit 3 (17–20 ka)	R	dent.	m1
147978	*Tamias (Neotamias)* large sp.	520NW505	Unit 1 (10–0 ka)	R	dent.	m1
147979	*Tamias (Neotamias)* large sp.	520NW505	Unit 1 (10–0 ka)	L	dent.	p4 m1
148191	*Tamias (Neotamias)* large sp.	510NW515	mixed Unit 1 & 2	L	dent.	m1-m2
148277	*Tamias (Neotamias)* large sp.	495NW510	mixed Unit 1 & 2	L	dent.	i1 m1
148405	*Tamias (Neotamias)* large sp.	510NW505	Unit 6 (>100ka)	L	max.	M1
148798	*Tamias (Neotamias)* large sp.	495NW515	mixed Unit 1 & 2	L	dent.	i1 m1